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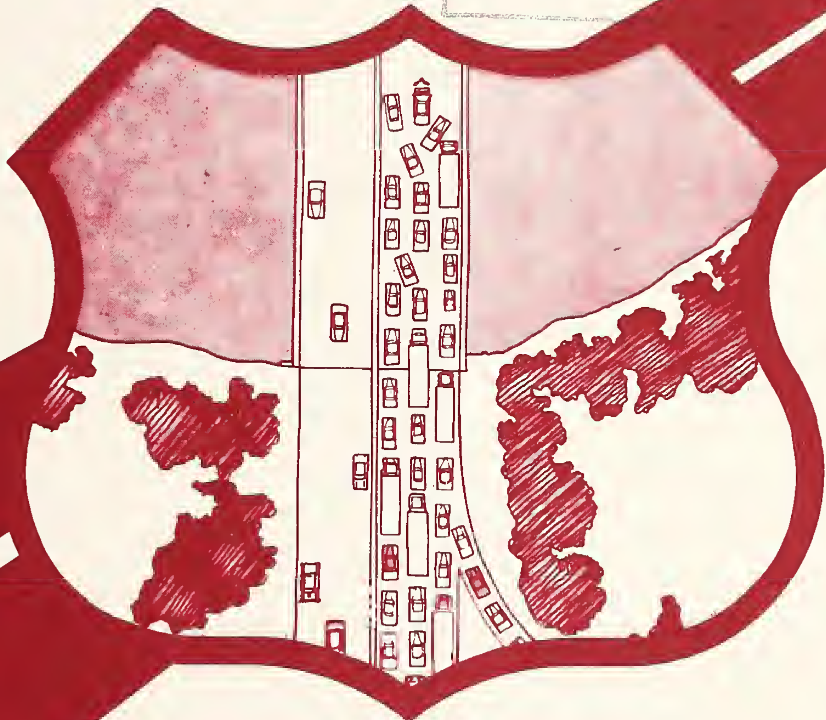
DEVELOPMENT AND TESTING OF INTRAS, A MICROSCOPIC FREEWAY SIMULATION MODEL

Vol. 2. User's Manual

October 1980

Final Report



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Prepared for

FEDERAL HIGHWAY ADMINISTRATION

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Washington, D.C. 20590

FOREWORD

This report is the User's Manual for the INTRAS program which is a microscopic freeway simulation model which can be used to evaluate alternative designs of and control systems for urban freeways. It can also be used to study related subjects such as detector station spacing and the efficacy of incident detection algorithms. This volume also contains the description of the COMMON storage arrays.

This report is the second volume in a four volume Final Report on the study, "Adaptation of a Freeway Simulation Model for Studying Incident Detection and Control."

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16. Abstract

This series of volumes documents the work performed to adapt a freeway simulation model for studying freeway incidents. The resulting program, INTRAS (INtegrated TRAffic Simulation), is a vehicle-specific time-stepping simulation designed to realistically represent traffic and traffic control in a freeway and surrounding surface street environment.

This volume describes the detailed procedures needed to apply the INTRAS Program to the study of traffic operations in a freeway environment.

This volume is the second in the series. The others in the series are:

Vol. No.	FHWA No.	Short Title
1	80/106	Program Design, Parameter Calibration Freeway Dynamics Component Development
3	80/108	Validation and Applications
4	80/109	Program Documentation

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1. INTRODUCTION

This report, Volume II of the Final Report for Contract No. DOT-FH-11-8502, is a User's Manual for the INTRAS (INtegrated TRAffic Simulation) microscopic freeway simulation program developed for the Federal Highway Administration. Volume I describes the development, calibration and freeway logical component validation of INTRAS. Volume III reports the results of system validation, incident detection algorithm validation and demonstrations performed with the simulation model. It is intended that this volume be a stand-alone document which will allow the use of INTRAS without referral to the other Final Report volumes. For that purpose, some text is repeated from Volume I.

Section 2 of this volume contains a full description of the purpose, structure, features and methods of INTRAS. Guidelines for traffic network representation are also provided. In Section 3, input data descriptions are presented. Output capabilities are defined in Section 4. Section 5 contains the operating procedures for executing INTRAS on the CDC 6600/7600 under the SCOPE operating system and on the IBM 360/370 under OS. A sample application is presented in Section 6. Appendices to this volume contain high level flow charts for the major logical program modules, error messages, COMMON block variable descriptions, and an index of subroutine cross references.

2. DEFINITION AND FEATURES OF THE INTRAS MODEL

This section of the INTRAS User's Manual is devoted to a description of the INTRAS simulation model and its major components. To provide the user with sufficient background to fully utilize INTRAS, detailed descriptions of the features included in the program are provided. Additionally, guidelines for representing a "real world" traffic network in the terminology of the program is presented. Section 2 should be understood before the user attempts to code the input card formats presented in Section 3.

2.1 Program Purpose and Capabilities

INTRAS has been developed for use in studying freeway incident detection and control strategies. It is based on knowledge of freeway operations and surveillance systems and incorporates detailed traffic simulation logic developed and validated for this project (Volume I).

To allow simulation of freeway control policies, including ramp metering and diversion, the capability of modelling the off-freeway environment is included in INTRAS. This "surface" traffic modelling is patterned after the logic of the UTCS-1 simulation model (Refs. 1 and 2)

To facilitate the simulation of closed loop incident detection and control, as well as off-line traffic analysis, the INTRAS model contains a realistic surveillance system simulation capability. The ability to visualize vehicle trajectories, and contours of Measures of Effectiveness (MOE's) in the time-space plane, is included in INTRAS via a digital plotting module. INTRAS also contains a statistical analyses module which permits comparison of MOE's from different simulation runs or field data, utilizing standard parametric and non-parametric tests.

Finally, a fuel consumption and vehicle emission evaluation module is built into INTRAS patterned after a similar module developed for the UTCS-1 simulation model.

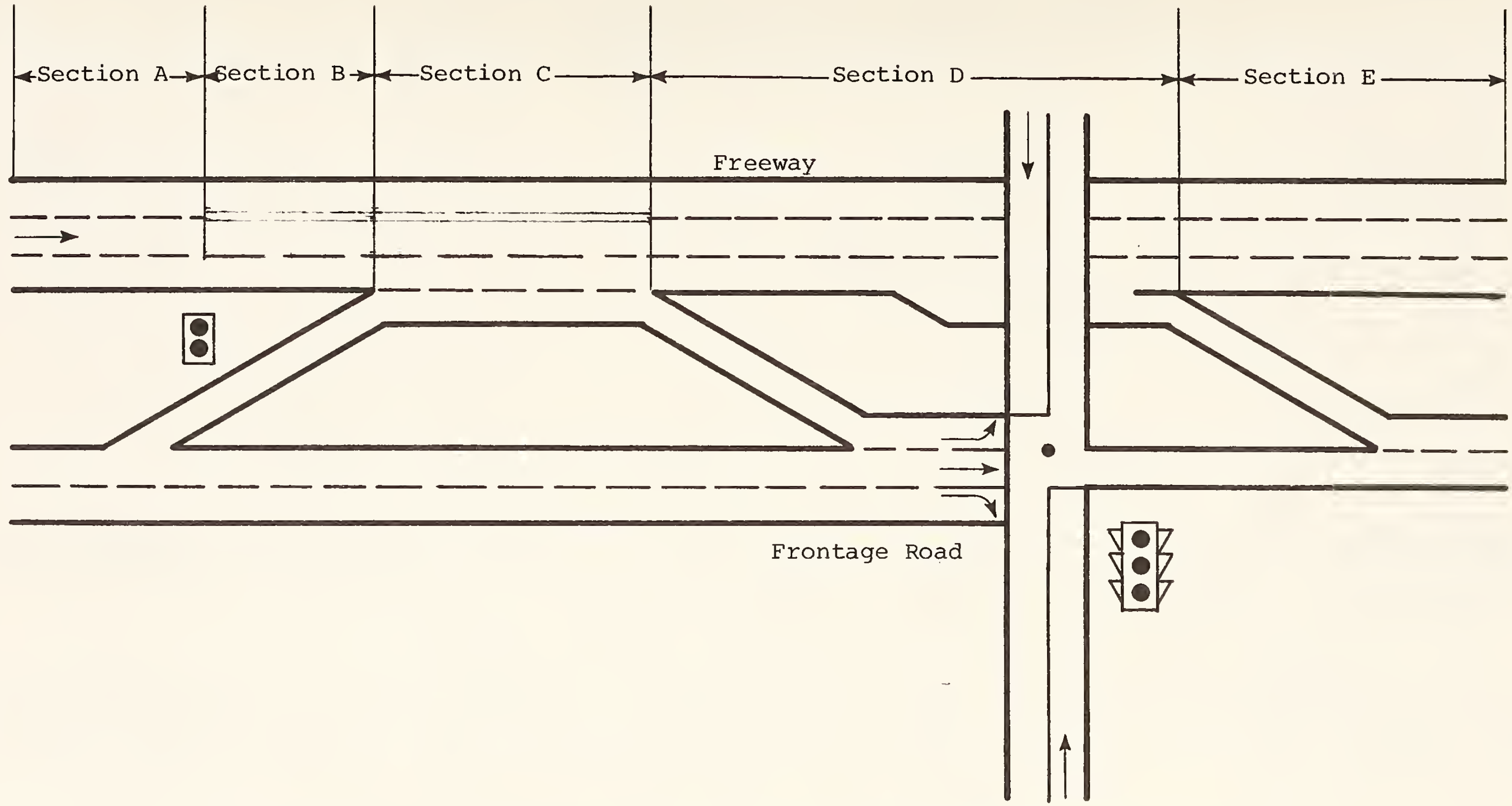


Figure 1: Sample Physical Freeway-Frontage Road Network

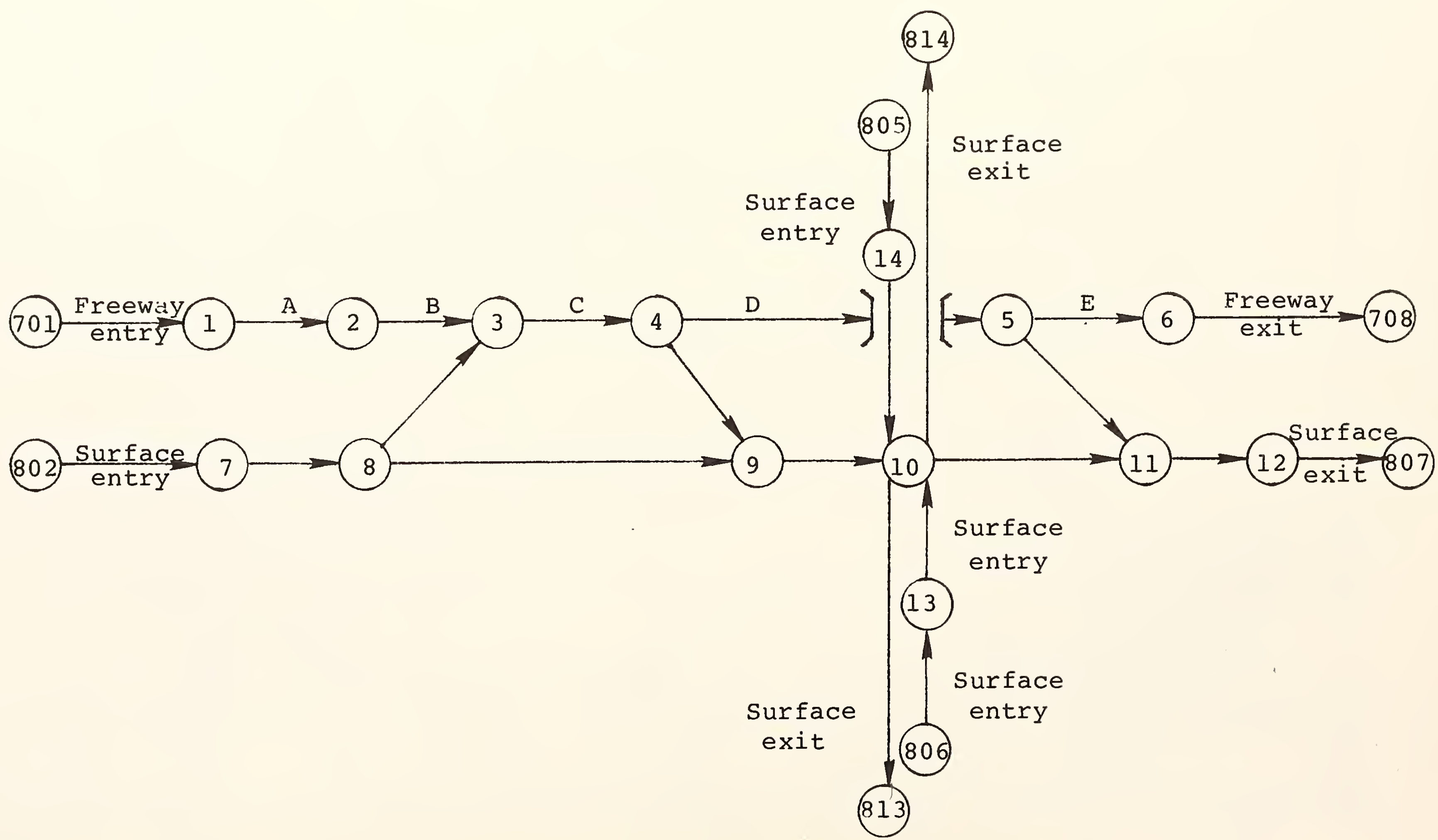


Figure 2: Representation of sample network

2.2 Network Idealization and Modelling Concepts

The representation of a "real world" traffic system in the terminology of INTRAS is the most important task a user faces. The simulation results cannot reflect the workings of the actual traffic system unless it is accurately represented to the model. The model's concept of the real network is built upon the data supplied; i.e., measurements of various network features and characteristics. A familiarity with definitions of these features is, therefore, required for the user to successfully utilize INTRAS.

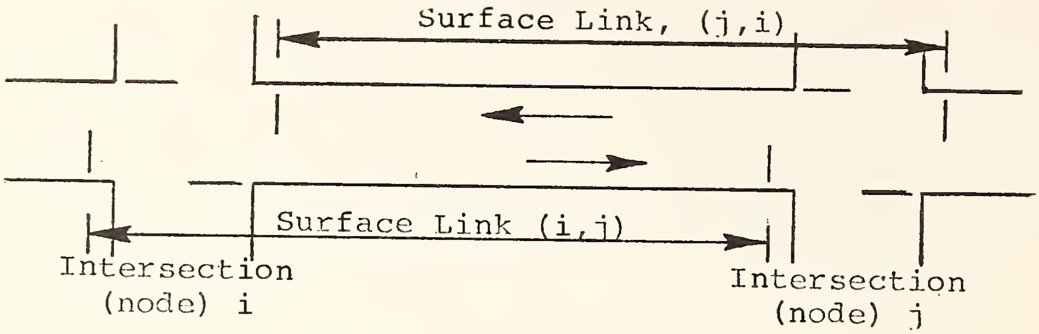
2.2.1 Network Representation

The geometric representation of a roadway system for the INTRAS model is comprised of links (one-directional roadway segments) and nodes (intersections or geometric discontinuities). The logical division of a road system into links may correspond to the natural segmentation caused by cross streets or ramp junctions. Figures 1 and 2 represent a typical roadway system and its network representation, respectively. If analysis of a natural segment indicates different characteristics on one portion than on another, it may be desirable to further subdivide the segment. For example, if it is observed that on the upstream portion of a segment, traffic always travels at a slower speed than on the downstream, the actual segment may be represented in the model inputs by two links with differing free-flow speeds. A change in grade is also sufficient reason for further segmentation.

Implementation of this type of characteristic would be accomplished by the insertion of an additional node. For example, link (8,9) in Figure 2 might be partitioned into two links, (8,15) and (15,9), by the insertion of an intervening node 15.

To permit appropriate logical treatment for roadway sections of diverse characteristics, and to realize some computer storage economy, three link types are defined for INTRAS.

A Surface link is defined as a roadway segment servicing one direction of traffic. The nodes at each end represent at-grade intersections. Each "surface" link extends from the upstream stopline to the downstream stopline as in the following sketch:



As indicated (in the sketch), a link is normally identified by the upstream and downstream node numbers. Each "surface" link may consist of up to five lanes in width. Two of these lanes may be turning pockets (one left and one right) which do not extend for the full link length.

Vehicles traversing an INTRAS "surface" link are moved at constant time intervals utilizing the logic established in the UTCS-1 urban traffic simulation model. The method properly replicates (Ref. 2) the dynamics of traffic on urban networks.

A Freeway link is defined as a one-way roadway segment, of a controlled-access highway, characterized by generally constant geometric characteristics (grade, curvature, number of through lanes). The extremities of a "freeway" link correspond to either ramp junctions or significant geometric changes. Each "freeway" link may contain up to five through lanes and two auxiliary lanes. Each auxiliary lane may be described as "acceleration", "deceleration" or "full", as defined below:

Auxiliary Lane Type	Definition
Acceleration	A lane which extends from the upstream extremity of a freeway link to some mid-link position

Auxiliary Lane Type	Definition
Deceleration	A lane which extends from a mid-link position to the downstream extremity of a freeway link
Full	A lane which extends for the full length of a freeway link with at least one end connecting to an on or off-ramp

Auxiliary lanes may occur on either the left or right-hand side of the roadway. Typical "freeway" links are illustrated in Figure 3.

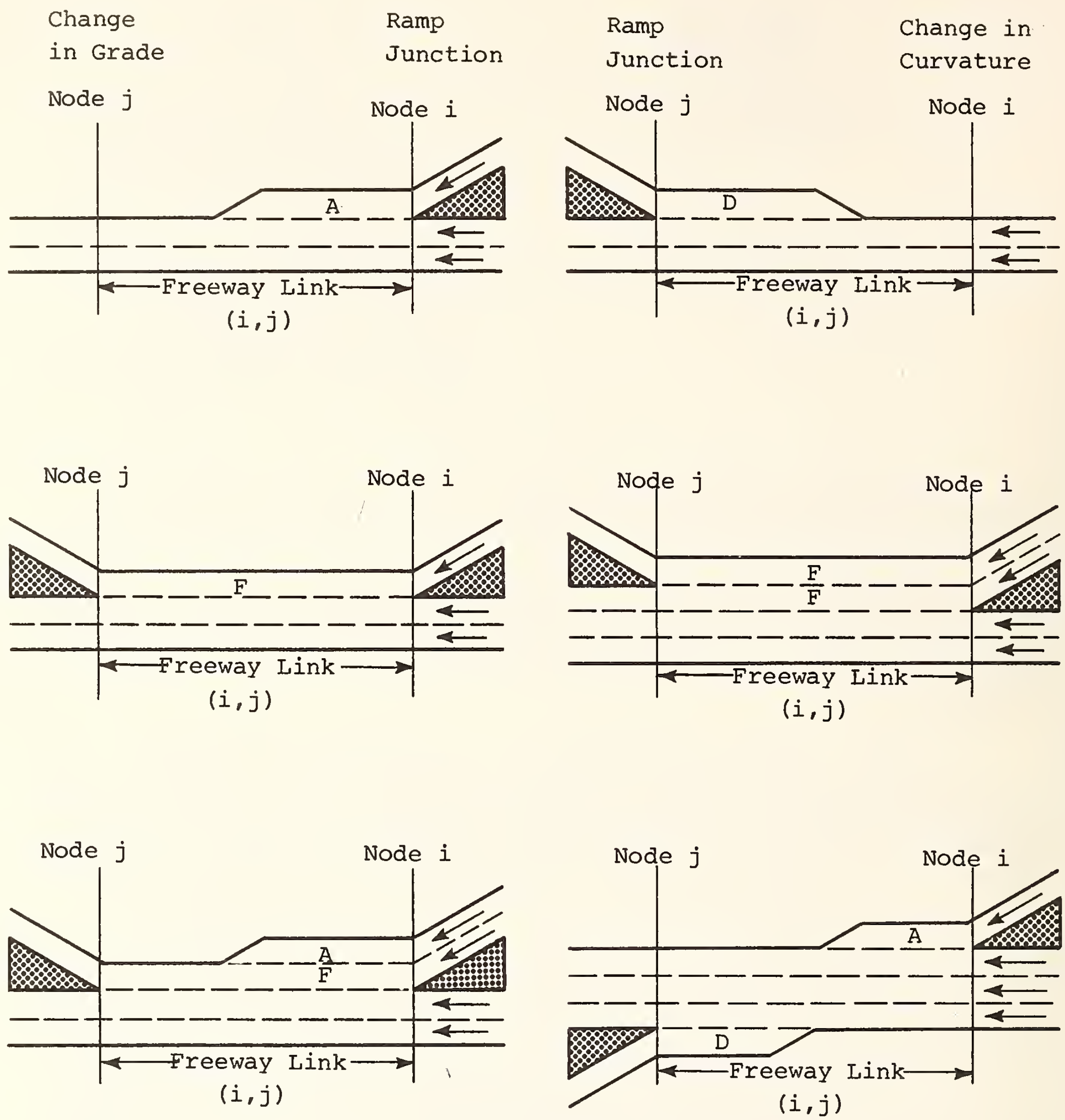
Vehicles traversing "freeway" links move in accordance with the logic of car following, lane-changing and vehicle generation component models developed for INTRAS (see Volume I).

A Ramp link is defined as a one-way non-freeway roadway segment which connects directly to a freeway link. Ramps may be one or two lanes in width. "Ramp" links are further characterized as either on or off-ramps indicating that end of the link which connects to the freeway.

The same logic is applied to move vehicles on "ramp" links as for "surface" links.

Because the simulated network is just a portion of some real world traffic system, special links have been devised to handle conditions at the network extremities. These links serve to process vehicles into and out of the simulated study network.

Links handling incoming traffic are called entry links. The INTRAS model allows both freeway and surface entry links. They are coded on input cards and processed the same as interior freeway and surface links but are subject to a few additional requirements. For freeway entries, auxiliary lanes may not be specified, nor pockets on surface entries. It is not necessary that these links be exact replicas geometrically of their real world counterparts.



Key:
A = Acceleration Lane
D = Deceleration Lane
F = Full Auxiliary Lane

Figure 3: Typical Freeway Link Configurations

What is important is that the incoming volumes, distribution of vehicle types, and incoming lane distribution (for freeway entries) be accurately specified. The performance of vehicles on these special purpose links are not included in the network totals of the output reports.

Traffic leaving the network is said to move on to exit links. These links are never coded on input cards and therefore not included in link data arrays or processed explicitly. The notion of exit links only exists in connection with traffic movements. If an interior link specifies a node on the periphery as a destination for some traffic movement (i.e., left-turn, thru or right-turn), then an exit link is implied and traffic may leave the network by it.

Nodes on the periphery of the network (i.e., upstream nodes of entries and downstream nodes of exits) are identified to INTRAS by node numbers greater than 699. Values from 700 to 799 are reserved for freeway peripheral nodes, while those from 800 to 899 represent nodes associated with surface entries and exits.

2.2.2 Geometric Features

To model a roadway system in sufficient detail to replicate "real world" traffic statistics, it is necessary to accomodate those geometric features which significantly affect traffic performance. These features included in the INTRAS design are described below.

Intersections - The junction of surface links with either other surface links or ramp links are modeled as in the UTCS-1 program. Each intersection is identified by a unique node number. Links are identified by the ordered pair of node numbers which identify their upstream and downstream extremities. There may be up to four links approaching, and four links departing, a given intersection (node).

Vehicles on each approach link to an intersection may have up to three destinations (receiving links) upon passing through that intersection. Each of these receiving links is entered by performing the associated traffic maneuvers: left turn, through movement or right turn. Left turners seek gaps in opposing traffic; right turners slow before turning, etc.

Freeway-Freeway and Freeway-Ramp Interconnections - The lane alignment of freeway links and on-ramp links with the next downstream freeway link is defined by two input specifications. First, the number and type (through, auxiliary) of lanes which comprise each link is specified. Second, the lane in the downstream link which receives traffic from the right-most through lane of the upstream link must be identified.

Lanes are labeled for identification via the following convention. The through lanes of each freeway link (and all lanes of ramp links) are numbered sequentially from right to left (i.e., the right-most through lane is always labeled "1"). The left-hand auxiliary lanes are numbered 6 and 7, respectively, with lane 6 adjacent to the freeway lane. Right-hand auxiliary lanes are numbered 8 and 9, respectively, with lane 8 adjacent to the freeway lane.

Freeway links are logically connected to downstream off-ramps by specifying the number of ramp lanes, and whether it is a right-hand or left-hand off-ramp. The outside lanes on the designated side of the freeway are then internally assigned as connecting to the off-ramp.

As clarification of this convention, the following example is provided:

Figure 4a illustrates a roadway section containing four freeway links, one on-ramp, and two off-ramps. Figure 4b contains the network idealization for the same roadway section. In this example, the alignment of freeway links and on-ramps is given in the following table:

Feeding link	Receiving link	Receiving lane for lane 1 traffic
1,2	2,3	1
2,3	3,4	8
3,4	4,5	1
6,2 (on-ramp)	2,3	8

The off-ramp alignment is implicitly determined in INTRAS by the specification that left exiting vehicles from 2,3 enter 3,7 and right exiting vehicles from 3,4 enter 4,8. This specification, coupled with the number and definition of lanes in the four links, is sufficient to define alignment.

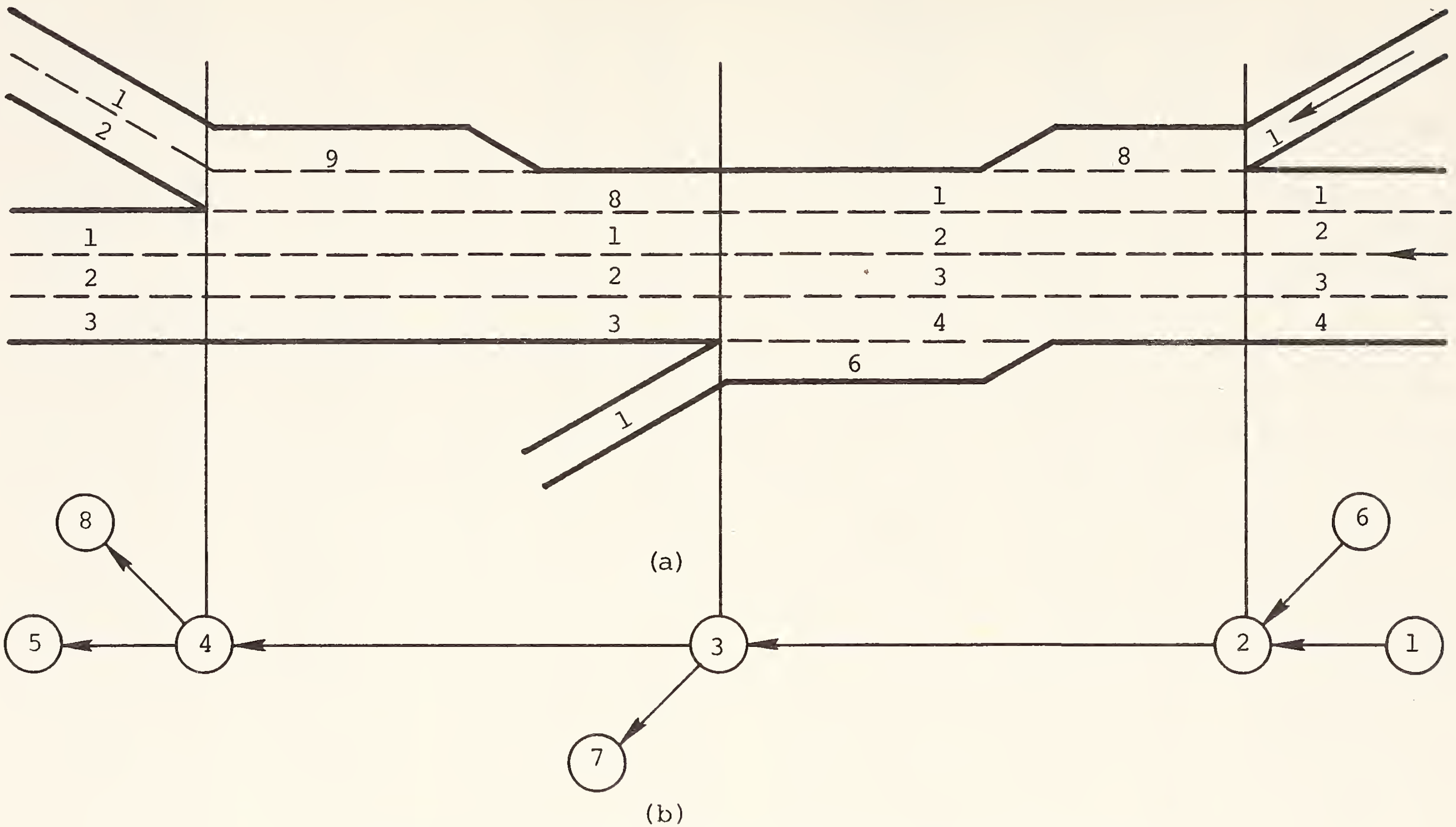


Figure 4: Ramp-Freeway Interconnection Example

Grade specification - INTRAS has been designed to accept link-specific grade as input. Thus, it is proper to define a continuous section of roadway (containing a significant change in gradient) as two contiguous links, with a node defined at the point where the grade changes. The INTRAS logic examines the link-specific grade specification to modify several operating parameters (see Volume I).

Curvature - As for grade, a change in horizontal curvature is sufficient reason to segment a roadway section into two links. Two methods of limiting vehicle performance on horizontal curves are available in the INTRAS design. First, a lowered value of desired free-flow speed may be defined for an affected link. Although easy to apply, this method presumes some pre-analysis on the part of the user.

Second, radius of curvature, super elevation and pavement condition may be defined. An internal table is referenced to determine friction coefficient from pavement condition. The basic equation for vehicle operation on a curve (Ref. 3), is then used to generate an upper bound for desired free-flow speed.

$$V = \sqrt{15R(e+f)}$$

where, e = rate of roadway superelevation, foot per foot

f = friction coefficient for given pavement condition

R = radius of curve in feet

V = vehicle speed, miles per hour

The simulation model applies the minimum of the input free-flow speed, and the curvature dictated upper bound, to traffic on the subject link.

Lane separation - The typical freeway often contains sections where lane changing is physically prohibited by virtue of barrier curbs or traffic islands. These restrictions are designed to segregate through traffic from weaving traffic, or, to guide vehicles around some obstruction (bridge abutments, etc.). INTRAS is designed to accept physical barriers of this nature on a link-specific basis.

2.2.3 Traffic Flow Patterns

Examination of the flow of traffic through a "real" traffic system is necessary to set up traffic flow patterns through a network. Turning movements (as percentages or counts) must be defined by the user in the model input. Lane channelization and early warning signs provide the model with information needed to guide vehicles into the proper lanes to negotiate these prescribed maneuvers.

Where surface lanes are restricted to a particular movement they must be coded as channelized. In some cases it may be appropriate to channelize lanes in the model inputs that are not channelized in the real system. This would apply where drivers avoid certain lanes because of heavy turning movements or turning movement restrictions. Consider a two-lane link with some percentage of traffic turning left. Drivers familiar with the road and not turning left may tend to avoid travelling in the left lane. The result is a natural channelization. In this instance, the left lane should be channelized in the model inputs as reserved for left-turning vehicles.

The early warning sign capability of INTRAS allows the user to define the point on the roadway at which drivers begin to react to an upcoming off-ramp. As simulated vehicles pass an early warning sign, they are assigned to either turn or remain on the freeway at the indicated off-ramp. Their desired lane thereafter reflects this downstream movement. If an early warning sign is not specified for a particular off-ramp, then vehicles do not exhibit lane preferences (due to the off-ramp) until they enter the freeway link which connects directly to the ramp.

One such sign may be coded in the model for each off-ramp. It must be positioned downstream of the previous off-ramp and upstream of the freeway link connecting directly to the specified off-ramp.

2.2.4 Signal and Sign Control

Each intersection in a simulated study network requires a control policy to establish the right-of-way for approaching vehicles. Similar to the UTCS-1 program, INTRAS has the ability to simulate both fixed-time signal control and sign control. Provision has been made for the modular inclusion and referencing of specially coded

subroutines to model traffic responsive signal control. Ramp metering and freeway traffic diversion procedures (described in later sections) utilize this provision.

Fixed-Time Signal Control - Intersections of an INTRAS simulated network may be controlled by fixed time signals of up to six control intervals each. During each interval, one of the following standard signal configurations is applied to control each of the approach links:

Amber
Green
Red
Red with Green Right Arrow
Red with Green Left Arrow
Red with Right Turn after Stop
No Turns - Green Through Arrow
Red with Left and Right Green Arrows
No Left Turn - Green Through and Right

The duration of each control interval is user-specified.

Traffic Responsive Intersection Control - A control module containing procedures similar to those in the UTCS-1 simulation have been implemented conforming to the NEMA standard.

Sign Control - Each intersection not controlled by a fixed-time signal is controlled by either stop or yield signs. The user must specify which approaches face such signs. For the common situation, where no control of any kind is present, the INTRAS user will need to specify yield signs for one approach direction to indicate the minor street.

2.2.5 Traffic Descriptive Features

Each driver-vehicle pair in a traffic stream behaves as an individual entity having different motivations and standards of performance from those around it. This quality must be modelled in INTRAS to achieve the proper stochastic variation in individual vehicle performance. To accomplish this, the INTRAS design provides for five vehicle types, each possessing its own family of vehicle characteristics (length, speed acceleration profile, etc.) These characteristics may be revised as an option, so that the particular vehicle types chosen for the basic INTRAS model do not constitute a limitation on the user. The vehicle-types chosen for the basic INTRAS model are:

High Performance Passenger Car
Low Performance Passenger Car
Intercity Buses
Single Unit Trucks
Trailer Truck Combinations

Further discussion of vehicle-type specific characteristics appears in Volume I.

Variations within vehicle types are attributed to differences in driver performance. Decile distributions of these characteristics (variation about mean free-flow speed, queue discharge headway, etc.) are implemented in the INTRAS model as in the UTCS-1 program.

2.2.6 Incident Simulation Capability

A comprehensive freeway incident simulation procedure has been designed for INTRAS. The user may specify either blockages or "rubbernecking" to occur on a lane-specific basis. Each incident may occur at any longitudinal position on a freeway link and extend for any desired length of time.

The character of an incident may be changed with time. It is possible to specify, for example, a two-lane blockage which, after some specified duration, becomes only a one-lane blockage. The lane from which the blockage is removed may then become unrestricted or subject to "rubbernecking".

"Rubbernecking" may be applied, without a corresponding blockage, to simulate a shoulder incident. The user will input a factor indicating the percentage reduction in speed for vehicles traversing the affected lane segment.

2.2.7 Surveillance System Simulation

To render the INTRAS model an effective tool for evaluating a "real world" traffic performance evaluation and control techniques, it is necessary to simulate "real world" information gathering (surveillance) systems. Three types of traffic detectors are to be simulated by INTRAS.

<u>Doppler radar</u> detectors are characterized in the model by the lane and longitudinal location at which vehicles are

detected. Each simulated vehicle crossing this location will cause the surveillance logic to output speed and time of actuation.

Short inductance loops are characterized by lane and longitudinal position, and loop length. Either of two output methods may be chosen by the user. A digital output form may be selected to simulate the time interval scanning method prevalent in many control systems. The output for this method consists of an (occupied, not occupied) status indication. Normally the detector scanning interval will be of shorter duration than the simulation time step. The on, off status of each detector for each scanning interval is obtained by interpolating vehicle position across the simulation time step, assuming constant acceleration.

An analog output form may be chosen which outputs the time and duration of actuation for each vehicle.

Coupled short inductance loops are described to INTRAS as two single short loops of equal length. The downstream loop is located by lane and longitudinal position. The upstream loop is implicitly located by defining the separation distance between the pair. The output for coupled pairs may either be analog or digital as for single loops.

All surveillance system output is made available for subsequent treatment by point processing (detector specific) and system evaluation (measure of effectiveness (MOE)) estimation and incident detection modules. Internal arrays are maintained to service the dynamic control logic (see the following section).

2.2.8 Freeway Traffic Responsive Control

Vehicles entering the freeway via on-ramps may be subjected (as a user option) to a variety of control techniques. In parallel to, or independent of on-ramp control, diversion of freeway vehicles to a parallel service facility may be simulated. Both metering of ramp vehicles and diversion of freeway traffic are accomplished on a node-specific basis via specially coded subroutines. This subroutine structure permits a modular replacement of control policies. Control parameters are entered through the normal input stream for each affected node, in a general format acceptable to all control policies.

2.2.8.1 On-Ramp Controls

Four methods of on-ramp control are to be implemented in the INTRAS model. A typical geometric configuration of a metered on-ramp site is shown in Figure 5. The ramp signal (at C in the figure) is assumed to be upstream of the ramp-freeway interface at B. The downstream section of the physical ramp, link (C,B) is represented as a ramp link. The upstream portion (D,C) is represented as a surface link, subject to the normal queue discharge logic applied at all signalized intersections. Optionally, node C may be removed, and the ramp control may be applied at node D. In this event (D,B) is represented as a ramp link. The signal indication at D then specifies the ramp metering rate, as well as the control to through traffic.

Clock Time Metering - To simulate clock-time control of on-ramps, one fixed metering rate (vehicles per minute) is specified at each such node. A countdown clock is assigned to each associated on-ramp and the signal is set to "green" each time the clock returns to zero. The signal is maintained at "green" until a vehicle is discharged, and is then set to "red". A non-compliance percentage (user specified) is applied to vehicles arriving during the "red" signal. The indicated percentage of vehicles will be discharged through the "red" signal.

Demand/Capacity Metering - An evaluation of current excess capacity, immediately downstream of the metered on-ramp, is performed at user specified intervals. A maximum metering rate is calculated such that capacity of this freeway section is not violated. This metering rate is applied as for clock-time metering. A minimum metering rate of 1 vehicle/60 seconds is applied to ensure that waiting vehicles are not "trapped" (i.e., as in Section D,C of Figure 5).

In addition to the evaluation period, the user must specify the following parameters for each on-ramp operating under demand/capacity metering control:

- Capacity at downstream freeway station
- Freeway link to which capacity applies
- Identify detectors on that link which provide input to the metering algorithms.

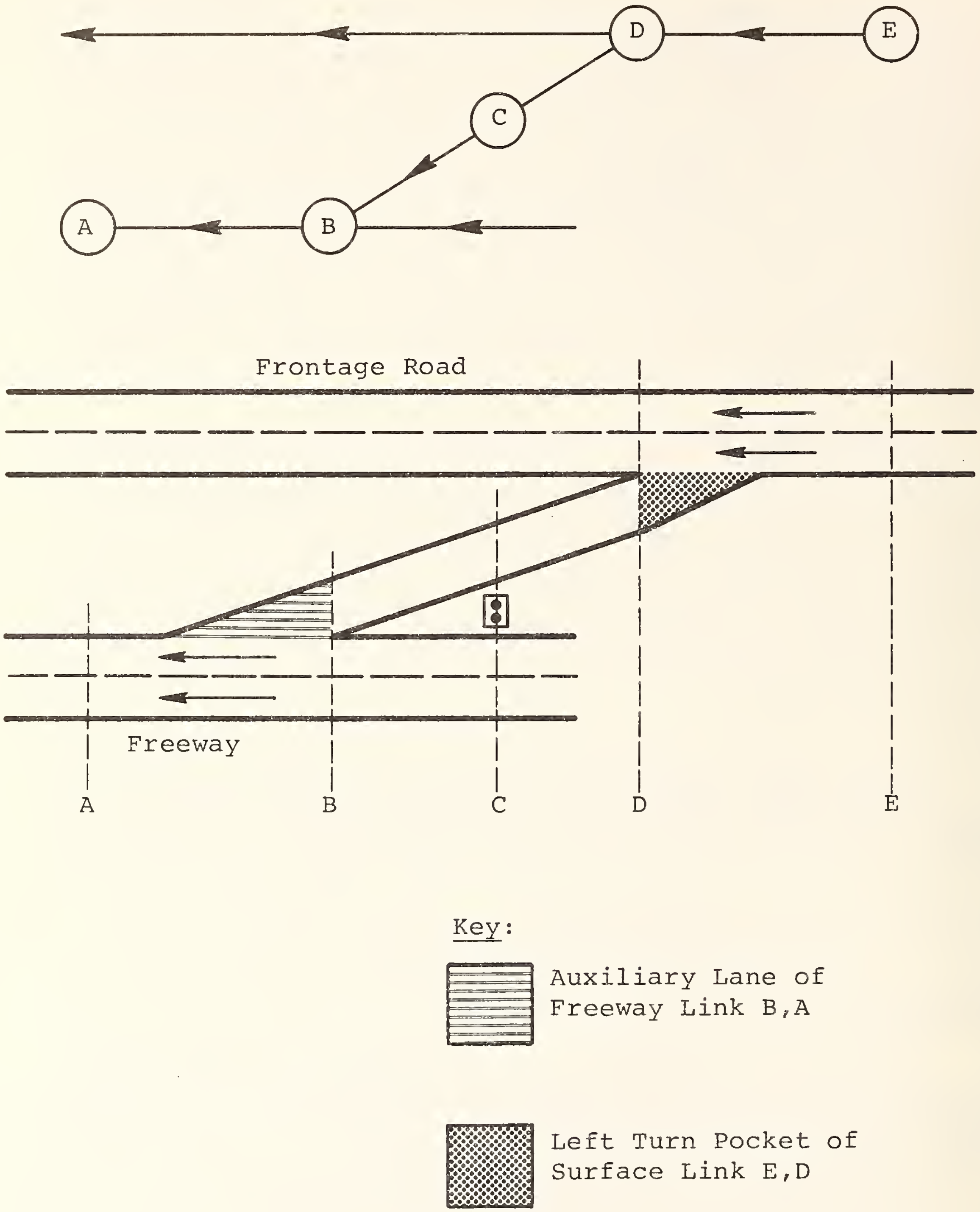


Figure 5: Typical Metered Ramp Geometry

Speed Control Metering - The procedure for this form of ramp metering is rather similar to the demand/capacity description above. A freeway link detector station must be established and identified at which speed evaluations are to be made to establish a metering rate. Generally, this location will be upstream of the on-ramp, although the logic will not preclude other placements. The user must specify a table of speeds, and metering rates, for each speed controlled on-ramp. As each evaluation period concludes, the prevalent speed, at the datum freeway station, will be compared to the tabular speed minimums to determine the proper metering rate.

Gap Acceptance Merge Control - This method of ramp control employs the ramp signal control to release ramp vehicles so as to merge smoothly into gaps* detected in the outside freeway lane traffic. The input required to implement this procedure is simplified in that no evaluation period nor metering rate criteria is required. A coupled pair of loop detectors must have been defined (via surveillance system specifications) in the outside lane of the upstream freeway link. The link identification and detector position must be identified to the gap acceptance algorithm, for each ramp, as well as the minimum acceptable gap size.

Gaps detected in the traffic stream are projected downstream to the merge point. The merge point gap size will be adjusted to reflect the relative speeds of the leading and following vehicles. As in the design of a physical system, the user will have to exercise care that one of the following two logical absurdities does not occur:

- The detector is so close to the merge point that vehicles at the ramp signal cannot be released in time to enter an acceptable gap

- The detector is so far upstream as to significantly affect the accuracy of the projected gap size.

All of the above ramp control methods are subjected to built-in distributions reflecting (by driver-type), maximum tolerable delay for queue leader, and willingness to join a queue. These distributions are imbedded in the modular ramp control subroutines.

*Gaps are expressed in units of time.

2.2.8.2 On-Freeway Diversion

Two procedures for diverting freeway vehicles to a parallel service facility will be programmed as subroutines of INTRAS. Both procedures will involve assignment of some portion of the through vehicles (at each freeway-off-ramp junction) to the off-ramp. Each diverted vehicle will be assigned to a user specified path, eventually leading either out of the network or back to the freeway.

Clock Time Diversion - This diversion method will apply a user specified percent of through vehicles to be diverted to each affected off-ramp. The time at which diversion begins must also be specified as well as the subsequent routing for each vehicle.

Least Time Path Diversion - For this procedure, travel time will be monitored for freeway paths and user-specified alternate paths which rejoin the freeway at some downstream node. When, and if, an all-freeway path is more time consuming than its alternate, vehicles will be diverted at the appropriate off-ramp.

2.2.9 Detector Output Processing

The simulated surveillance system produces output analagous to that generated by an on-line system. This output is stored on a peripheral device as a sequential file. At the conclusion of the simulation, this file may be saved for subsequent processing or analyzed immediately. The following procedures for analyzing detector data are included in the INTRAS design.

- Point processing procedures process each individual detector's output to generate local estimates of traffic flow parameters

- Measure of Effectiveness (MOE) estimation procedures, provided by FHWA, generate system-wide or subsystem (link)-specific parameters

- Incident detection procedures, provided by FHWA, analyze the detector data to identify the occurence of capacity reducing incidents.

All evaluations aggregate data over time intervals of user specified duration.

The following subsections describe the functions of these procedures in more detail.

2.2.9.1 Point Processing

Each detector on a roadway emits basic information as "raw" data. This "raw" data takes on different characteristics depending on the nature of the detector and the communications method. In "digital" mode each detector is polled at fixed intervals to determine current status (on-off, occupied-not occupied, etc.). In analog mode each detector sends a signal whose amplitude is proportional to the current measurement. INTRAS may operate in either digital or analog mode in simulating loop detectors. Simulated doppler radar detectors only operate as analog.

Table 1 describes the output of the detector types. Also shown are the parameters evaluated via point processing procedures. Each evaluation is detector specific. An assumed value of vehicle length is embedded in the point processing procedures to permit calculation of speed for single loops.

2.2.9.2 MOE Estimation

Procedures specified by FHWA will be implemented in INTRAS to estimate traffic performance parameters for freeway sections between detector stations. These procedures will operate on the data generated by detectors at the upstream and downstream stations. Estimates of area-related parameters (travel time, density, delay, etc.) will be generated to characterize traffic performance in the study sections.

2.2.9.3 Incident Detection

The primary goal of the subject project is to develop a simulation model to be used for the study of freeway incident detection and control. As described earlier, the INTRAS design includes comprehensive incident and surveillance system simulation capabilities. The INTRAS

Table 1: Output of INTRAS Simulated Detectors

Detector Type	Analog Output	Digital Output	Point Processing Output
Single Loop	Time and Duration of actuation	Occupied-not occupied Status	Volume Time Mean Speed Mean Time Headway Mean Occupancy
Coupled Loops	Time and Duration of actuation for each loop	Occupied-not occupied status for each loop	Volume Time Mean Speed Mean Time Headway Mean Occupancy
Doppler Radar	Speed and Time of Actuation	———	Volume Time Mean Speed

model will contain algorithms (to be provided by FHWA) to analyze the detector data and determine whether or not an incident has occurred on the simulated freeway. Either "raw" detector data or the results of the point processing procedures may be used as input to the incident detection algorithms.

The output of these procedures will be the time of detection of both the onset and end of each incident. When all detector data for the full simulation run has been processed, a comparison of the performance of the detection algorithms with the actual simulated history will be generated. The MOE of interest will include time until detection (both onset and end of incident), percent of real incidents detected, and percent false alarms.

2.3 Simulation and Programming Method

The INTRAS simulation model employs a time stepping procedure for moving discrete vehicles through the simulated traffic network. Each time step all vehicles in the network are processed in accordance with their desired speeds and destinations inhibited by the immediate traffic and control environment. A description of the various traffic and network characteristics modelled by INTRAS was presented in Section 2.2.

To accomplish the traffic simulation and provide all of the capabilities noted in Section 2.1 effectively and economically, certain core storage saving procedures are imbedded in INTRAS. An overlay structure is employed which ensures that only the storage needed for each particular application is required to execute INTRAS.

The allocation of core to link and vehicle arrays is economized by packing multiple parameters within each storage element (word/halfword). The retrieval and storage of these individual parameters is simplified by adopting generalized parameter packing and unpacking procedures. These procedures work in conjunction with a storage reallocation method which allows maximum use of the available link and vehicle storage, during execution, by revising storage devoted to these functions as needed. A detailed description of these features is presented in the Final Report, Volume I.

Error conditions encountered during processing are reported via a generalized error procedure. This procedure is detailed as part of the INTRAS output descriptions of Section 4. The error messages are presented in Appendix B. Use of this procedure conserves program storage and allows more detail in the error messages.

2.4 Assumptions and Limitations

Certain restrictions on network geometry and parameter values were required before the programming of INTRAS could begin. Reasonable values for these restrictions were chosen by considering the mission of the program and then determining limitations which could not reasonably be considered to interfere with the expected applications. These design limitations are the subject of this section.

In Section 2.6 the procedures for expanding array storage (to accomodate more links, vehicles, nodes, etc.) are presented. The maximum possible expansion of these arrays is limited by both total computer storage available and some designed maximum allowable value of the individual element identifier (i.e., freeway link number). The limitations designed into INTRAS are presented in Table 2

The geometry of the simulated network is restricted as to link lengths, maximum allowable lanes on each link, and number of approaches to each node. These restrictions are identified in Table 3. Similar in nature to the geometric restrictions is the limitation on signal control intervals. A maximum of six such intervals are permitted for signal controlled intersections.

In the calibration of INTRAS (Volume I) assumptions were made as to the degree of detail required to accurately represent the dynamic characteristics of freeway traffic. A maximum of five vehicle types were defined. The first two types are allowed to exhibit different acceleration characteristics in the freeway and non-freeway environments.

Five grade categories are provided. The first of these categories is assumed to represent a negative gradient, and so, no limitation on desired speed (due to grade) is designed for this category.

Table 2: INTRAS Parameter Limits

Definition	Limitation
Freeway Vehicle Numbers	$\leq$ 3200
Ramp Vehicle Numbers	$\leq$ 3200
Surface Vehicle Numbers	$\leq$ 3200
Freeway Link Numbers	$\leq$ 299
Ramp Link Numbers	$\leq$ 299
Surface Link Numbers	$\leq$ 299
Node Numbers (excluding peripheral nodes for exit and entry definition)	$\leq$ 699
Freeway Peripheral Nodes	> 699, $\leq$ 799
Surface Peripheral Nodes	> 799, $\leq$ 899
Detector Numbers	$\leq$ 3200
Incident Numbers	$\leq$ 99

Table 3: INTRAS Geometric Limits

Definition		Limitation
Number of Through Freeway Lanes per Link		$\leq$ 5
Number of Auxiliary Freeway Lanes per Link		$\leq$ 2
Number of Ramp Lanes per Link		$\leq$ 2
Number of Surface Lanes per Link (including pockets)		$\leq$ 5
Number of Right Turn Pockets per Surface Link		$\leq$ 1
Number of Left Turn Pockets per Surface Link		$\leq$ 1
Length of Freeway Links		$\leq$ 9800 feet
Length of Surface and Ramp Links		$\leq$ 3265 feet
Number of Approaches to Surface Intersection	(Node)	$\leq$ 4 surface links
	or	$\leq$ 3 surface links and 1 ramp link
Number of Approaches to Freeway Intersection	(Node)	$\leq$ 1 freeway link
	or	$\leq$ 1 ramp link

It is assumed that acceleration may be held constant for each vehicle type-grade combination over speed ranges of 20 feet per second extent.

It is important to note that the actual calibrated values of acceleration, limiting speed and grade categories (as well as numerous other calibration parameters) may be revised via data card input (See section 3). The restrictions noted in the preceding paragraphs affect only the number and character of the referenced attributes.

2.5 Functional Structure of INTRAS

The INTRAS model is a highly complex system containing procedures for multi-purpose input processing, diagnostic testing, microscopic traffic simulation, output reporting, statistical analysis, detector output processing and digital plotting. Reliable and efficient use of such a system depends on the system structure and organization. Early in the development of INTRAS, the time ordering of the above procedures was determined. The independent portions of each procedure were identified and isolated. This planning function provided a basis for the structural design of INTRAS.

One danger encountered in the implementation of large complex programming systems is that, when they are completed, storage restrictions may limit their usage to trivial applications. To achieve meaningful results it may then be necessary to segment the system. This unplanned segmentation often leads to loss of efficiency and debilitates certain features of the original plan. It is of utmost importance to design a system functionally, so that segmentation is planned, and the logical flow between segments occurs in the most efficient way, consistent with project goals.

INTRAS is designed with these factors in mind. The functional segments are overlayed so as to provide maximum computer storage for arrays and scalars. The maximization of data storage assures the greatest utility from the standpoint of treating large traffic networks. Major portions

of the data storage are optimized to increase network size capabilities to the maximum. This optimization is discussed in Volume I.

The overlay structure and information transfer of INTRAS is illustrated in Figure 6. The purpose of and methods employed by each functional segment (overlay module) are as follows:

The INTRAS Supervisor Module

Purpose: To call the functional modules in the order indicated by the Run Control specifications.

Method: For each case the first module to be transferred to is determined from examination of the Run Control card parameters. Subsequent transfers are determined by the individual modules and communicated by a control variable (NEXCAL).

The PORGIS Module

Purpose: To examine all simulation oriented input data for errors or inconsistencies and generate printed tables of input data. PORGIS may also store error-free simulation case data on tape.

Method: Information on each card of the input file is examined throughly for compatibility with the INTRAS model. Any items that do not conform with INTRAS specifications are reported by use of coded error messages. Input sequence checking and various logical checks on the network are also performed. When all input has been processed and is determined to be error free, the input tables are printed and, if desired, the data is written on the Case Data Tape.

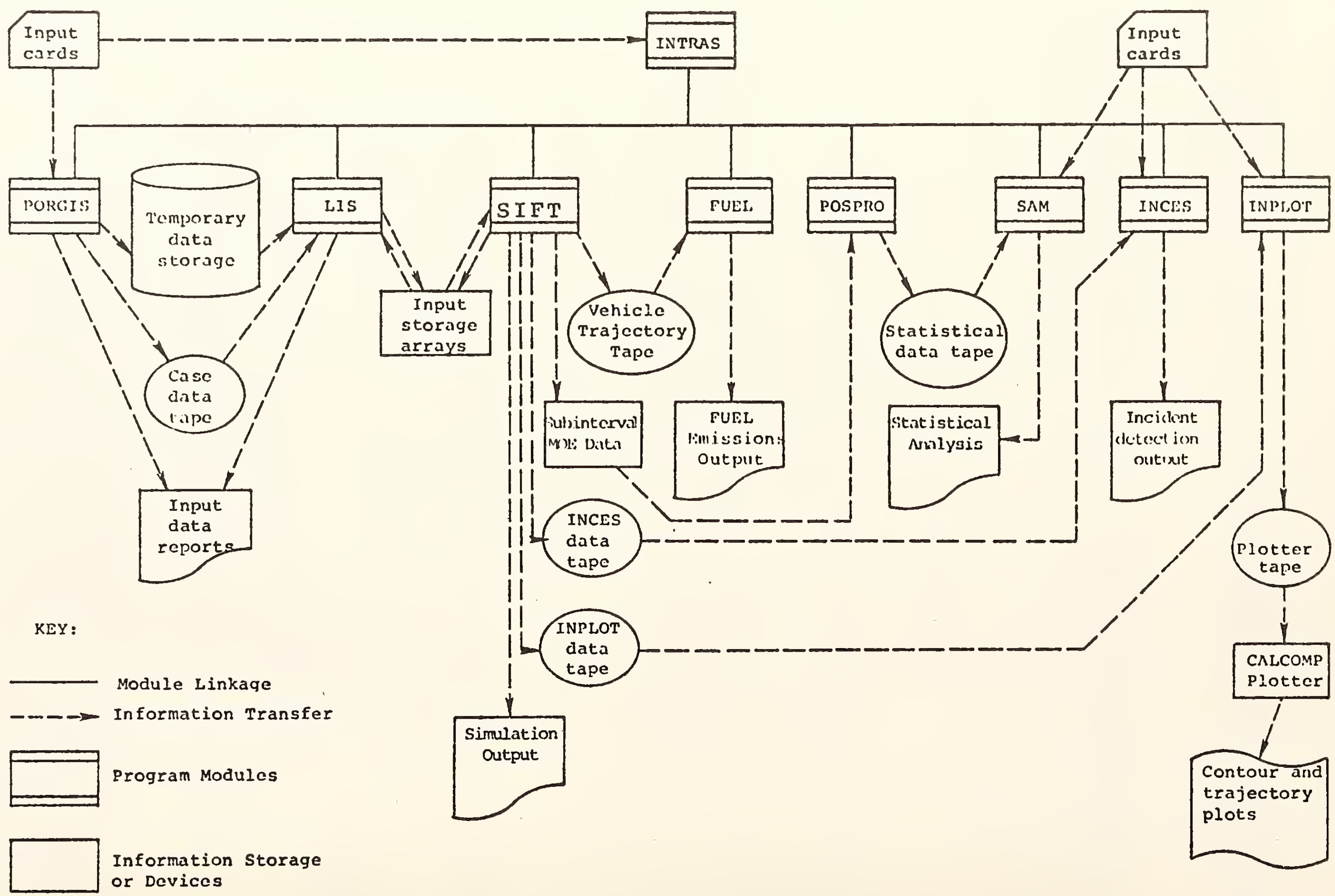


Figure 6: Functional Structure and Information Transfer of INTRAS

The LIS Module

Purpose: To load simulation case data into data arrays and scalars in preparation for execution of a simulation subinterval. LIS may also retrieve and execute error free data sets stored on the Case Data Tape.

Method: Arrays and scalars for this subinterval are primed with data taken from card input or the Case Data Tape. Each new subinterval requires a pass through LIS to update appropriate arrays and scalars with subinterval specific data and output the revised data.

The SIFT Module

Purpose: To perform all simulation activities.

Method: SIFT makes use of two lower level overlays to accomplish its tasks. Routines which perform frequent processing activities (at least once per time step) form one segment. The other segment contains those routines which perform relatively infrequent processing activities. At the beginning of each new time step the high frequency activity overlay is called. The low frequency activity overlay can be called from several locations depending upon the options requested.

The FUEL Module

Purpose: To provide link-specific evaluations of fuel consumption and vehicle emissions throughout a simulation run.

Method: Calculations of fuel consumption and emissions (carbon monoxide, hydrocarbons, and nitrous oxides) are based upon the dynamics of individual vehicles at each time step. These data are stored by SIFT on the Vehicle Trajectory Tape for all vehicles. FUEL reports MOE values at the

end of each simulation subinterval. Tables defining the response surfaces of emission rates and of fuel consumption rates, in the speed-acceleration plane, for each vehicle type, are a part of the FUEL module, but may be over-ridden by user supplied card input. The default data tables are representative of the following assumed characteristics for the INTRAS vehicle types:

High performance passenger car - 8 cylinder
Low performance passenger car - 4 and 6 cylinder composite
Intercity bus - diesel powered
Single unit trucks - gasoline powered
Trailer truck combinations - diesel powered

This module consists of a single main program plus a series of BLOCK DATA routines defining the tables.

The POSPRO Module

Purpose: To create a file of simulation statistics on the Statistical Data Tape for future processing by the SAM Module.

Method: At the end of each simulation subinterval the subinterval link-specific and network statistics are added to a temporary file. When the simulation run is completed the temporary file contents are added to the Statistical Data Tape.

The SAM Module

Purpose: To perform statistical comparisons between pairs of simulation runs or between a simulation run and field data.

Method: Statistical run control and data cards are read and processed. Any errors or inconsistencies are reported through coded error messages. If no errors are found the comparisons are performed and the results output.

The INCES Module

Purpose: To perform all processing of detector data and to generate incident detection, point processing, and MOE reports.

Method: A total of three incident detection algorithms have been implemented:

Algorithm 1 is the California logic, as presented in Ref. 4. The logic uses occupancies at sensor stations to determine the onset of the incident, its approximate location and the end of the incident.

Algorithm 2 is the Payne Algorithm 8 (Ref. 9). This algorithm incorporates compression wave suppression logic to avoid incident false alarms due to the presence of transient compression waves in the traffic flow.

Algorithm 3 (Ref. 8) uses the method of double exponential smoothing in an attempt to reduce the number of incident false alarms.

Point processing statistics may be computed for each detector on the network. Three methods of MOE estimation have been implemented:

Method 1 is based upon the work of Gazis and Knapp (Ref. 7). Density is estimated based on initial conditions and inflows and outflows from the road section under consideration. Kalman filtering is used.

Method 2, developed by Gazis and Szeto (Ref. 5) uses a Kalman filtering technique to estimate density based on initial conditions.

Method 3 (Ref. 6) uses speeds and counts at sensor stations to estimate density. A recursive minimum mean square estimator with Kalman gains is used.

The INPLOT Module

Purpose: To prepare vehicle trajectory and MOE contour plots based upon data on the INPLOT Data Tape.

Method: Plot types are generated in the time-space plane. The space axis may represent one or a group of contiguous freeway links. The user may request vehicle trajectory plots, in a single lane, or for

all lanes, in a specified freeway section. The available MOEs considered in the contour plots are: spot speed, volume, density, delay/vehicle-mile, headway and travel time/vehicle-mile as specified by the user. Contours are plotted for a standard set of values of each MOE embedded in INPLOT arrays. These standard values may be revised via the INPLOT parameter card. In addition to this option, an index may be created which details the current contents of the INPLOT Data Tape.

2.6 Size Modification Procedures

INTRAS is a tool for use in developing incident detection strategies and surveillance and control policies on freeway networks. Its standard capacities are as follows:

Feature	Program Variable Name	Maximum Number Allowable
Total Link and Vehicle Storage Elements	MNLV*	15000
Total Links of All Types	NTOTL	110
Nodes or Entry Links	NTOTN	50
Detectors	NDET	100
Incidents	NINCI	10
Actuated Nodes	IANOD	10
Freeway Statistical Data Stations	NSTATN	10

*Note that each: freeway link uses 42 elements of MNLV
ramp link uses 18 elements of MNLV
surface link uses 22 elements of MNLV
freeway vehicle uses 22 elements of MNLV
ramp vehicle uses 8 elements of MNLV
surface vehicle uses 8 elements of MNLV.

Certain cases may require modifications of these capacities. Any increases will, of course, change the core storage requirement and computer running costs. The following procedures define the necessary steps for changing any or all of the above capacities.

2.6.1 Changing Size of Link and Vehicle Storage Space

The NLV array of COMMON /A1/ contains all link and vehicle arrays. Large networks, i.e., networks with many links or heavy volumes, may require more link and vehicle storage space in which case the NLV array must be expanded. To change NLV, do the following:

1) Change the value of MNLV in BLOCK DATA INTVAR to the new number of elements available for storage of link and vehicle arrays.

2) Change size of NLV array in all routines containing COMMON /A1/. Refer to Table 4.

3) Change associated dimension statement in all routines containing COMMON /A1/ so that the number of elements used for each freeway, ramp and surface link and vehicle array is less than or equal to MNLV.

<u>Example</u>:

Consider the problem of increasing link and vehicle storage from 10000 elements to 15000.

1) Change the data statement in BLOCK DATA INTVAR from

```
      DATA MNLV /10000/
```

to

```
      DATA MNLV /15000/
```

2) In all routines containing COMMON /A1/ change the COMMON /A1/ statement from

```
      COMMON /A1/ MNLV,NLV(10000)
```

to

```
      COMMON /A1/ MNLV,NLV(15000)
```

3) In all routines containing COMMON /A1/ change the DIMENSION statement from

```
      DIMENSION LNKF(42,238),LNKR(18,555),
     LNKS(22,454),VF(22,454),VR(8,1250),VS(8,1250)
```

to

```
      DIMENSION LNKF(42,357),LNKR(18,833),
     LNKS(22,681),VF(22,681), VR(8,1875),VS(8,1875)
```

Table 4: Subroutine - COMMON Block
Cross Reference Chart

INTRAS Module Routines																			
LRANK	NEXTLN	FINDL	FINDLN	PVS	PVR	PLNKS	PLNKR	PAK	UNPAK	UVS	UVR	ULNKS	ULNKR	INTVAR	DRWS	DBUG	EROT	INTRAS	COMMON Blocks
X	X		X	X	X	X	X	X	X	X	X	X	X	X		X		X	A1
X		X	X											X				X	A2
		X	X											X				X	A3
														X				X	A4
														X				X	A5
														X				X	A6
																		X	A7
																		X	A8
																		X	A9
																		X	A10
														X				X	A11
																		X	A12
														X				X	ACT0
																		X	ACT1
																		X	ACT2
																		X	ACT3
																		X	ACT4
																		X	ACT7
																		X	ACT8
																		X	ACT9
																		X	ACT10
																		X	ACT12
																			ACT16
																		X	ACT20
																		X	CFUEL
		X													X	X		X	CONTRL
														X					CRASH
																		X	DBLEXP
		X													X		X	X	ERTRAN
																		X	FORINC
																		X	FPAR
																		X	FREDAT
																		X	IHEAD
																		X	IPLTN
																		X	LASDCH
																		X	NFILTS
																		X	ONVEH
																		X	P1
X																		X	RANK
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		X	SIZE
		X												X				X	S1
																X	X	X	S2
																		X	S3

Table 4: Subroutine - COMMON Block Cross Reference Chart (cont.)

PORGIS Module Routines																										
INT1	TURNIN	LINOUT	CHKNOD	LINKIN	MATCH	DETGEN	IMBEDO	IMBED	INCOUT	SUROUT	FLOOUT	INACT	SIGOUT	INCIN	SURVIN	PRMSND	CLRALL	CTPSV	CTPSX	CTPFF	PRACT	PRSIG	LPAK	TABCON	PORGIS	COMMON Blocks
X		X		X		X			X	X	X			X	X	X	X						X	X	X	A1
X	X	X		X					X	X	X	X	X		X	X	X			X		X	X		X	A2
X	X	X	X	X							X		X	X	X	X	X	X	X	X		X			X	A3
						X				X	X				X		X								X	A4
									X		X			X			X								X	A5
											X	X	X				X	X	X	X		X			X	A6
											X					X	X								X	A7
X	X	X		X		X	X	X		X				X			X								X	A8
				X	X												X									A9
																	X									A10
		X		X													X									A11
		X		X			X	X									X									A12
												X					X			X						ACT0
												X					X		X							ACT1
																	X									ACT2
																	X		X							ACT3
												X					X	X								ACT4
												X					X	X		X						ACT7
												X					X		X	X						ACT8
												X					X		X	X						ACT9
												X					X	X	X	X						ACT10
																	X									ACT11
																	X	X								ACT12
																	X									ACT16
																	X	X								ACT20
																									X	CFUEL
X	X		X	X		X		X	X	X	X		X	X	X	X	X	X	X	X	X	X		X	X	CONTRL
															X		X								X	CRASH
X	X		X	X		X		X			X			X	X	X	X	X	X	X	X	X	X	X	X	ERTRAN
																	X								X	FORINC
							X	X									X									FPAR
																	X									FREDAT
							X	X																	X	IHEAD
																										IMBDIN
																	X									LASDCH
																	X									NFILTS
																	X									ONVEH
		X		X							X						X						X		X	P1
										X															X	RANK
X	X	X		X	X				X	X	X	X	X	X	X	X	X			X		X	X		X	SIZE
X																										S1
																	X					X			X	S2
																	X									S3

Table 4: Subroutine - COMMON Block Cross Reference Chart (cont.)

LIS Module Routines																							
LINT1	LTURNI	LLINOU	LLINKI	LDETGE	LIMBDO	LIMBED	LINCOU	LSUROU	LFLOOU	LINACT	LSIGOU	LINCIN	LSURVI	LPRMSN	LCLRAL	LCTPSV	LCTPSX	LCTPFF	LPRACT	LPRSIG	LLPAK	LIS	COMMON Blocks
		X		X			X	X	X			X	X	X	X						X	X	A1
X	X	X	X				X	X	X	X	X		X	X	X			X			X	X	A2
X	X	X	X						X		X	X	X	X	X	X		X		X		X	A3
				X				X	X				X		X							X	A4
							X		X			X			X							X	A5
									X	X	X				X					X		X	A6
									X					X	X							X	A7
X	X	X	X	X	X	X						X			X							X	A8
			X												X								A9
															X								A10
		X	X												X								A11
		X	X		X	X									X								A12
										X					X			X					ACT0
										X					X		X						ACT1
															X								ACT2
															X		X						ACT3
										X					X	X							ACT4
										X					X	X		X					ACT7
										X					X		X	X					ACT8
										X					X			X					ACT9
										X					X	X	X	X					ACT10
															X								ACT11
															X	X							ACT12
															X								ACT16
															X	X		X					ACT20
																						X	CFUEL
X	X		X	X		X	X		X		X	X	X	X	X	X	X	X	X	X		X	CONTRL
													X		X							X	CRASH
													X									X	ERTRAN
															X							X	FORINC
					X	X									X								FPAR
															X								FREDAT
																						X	IHEAD
					X	X																	IMBDIN
															X								LASDCH
															X								NFILTS
															X								ONVEH
		X	X						X						X						X	X	P1
								X														X	RANK
X	X	X	X				X	X	X	X	X	X	X	X	X			X		X	X	X	SIZE
X																							S1
															X					X		X	S2
															X								S3

Table 4: Subroutine - COMMON Block Cross Reference Chart (cont.)

SIFT Module Routines																								
FZCL	DETSW	ASIG	ACTFZ	TERM	DECACT	TERMFZ	REDSIG	GRNSIG	UPACT	PDNAFZ	PDAFZ	SIGACT	UPSIG	HICON	RANDOM	FINDSV	FINDRV	FINDFV	LASTV	FRSTV	LASTLK	VPAK	SIFT	COMMON Blocks
																X	X	X	X	X	X	X	X	A1
														X										A2
		X											X	X										A3
													X	X										A6
																				X				A8
X	X		X	X		X	X	X	X		X	X												ACT1
X	X	X	X	X	X	X	X	X	X			X												ACT2
	X		X	X		X	X	X	X		X	X												ACT3
										X	X	X												ACT4
										X	X	X												ACT5
X			X	X		X				X	X	X												ACT6
												X												ACT7
X	X		X		X	X			X			X												ACT8
									X			X												ACT9
												X	X											ACT10
					X			X	X			X												ACT11
		X	X	X		X	X	X	X			X												ACT12
										X	X													ACT15
						X	X		X															ACT16
		X										X		X										ACT18
		X																						ACT20
																							X	CFUEL
													X	X	X							X	X	CONTRL
																							X	CRASH
																								DBLEXP
																X	X	X				X	X	ERTRAN
														X									X	FORINC
																							X	INCDMP
																							X	IPLTN
																							X	NIDTSV
																							X	NRGY
													X	X		X	X	X	X	X	X	X	X	SIZE
											X		X	X								X	X	S2
														X									X	S3
																							X	VBUF
																X	X	X					X	VPOINT

Table 4: Subroutine - COMMON Block Cross Reference Chart (cont.)

SIFT Module Routines (Cont.)																												
RELEN	FILL	SELEN	QSTATE	MOEV	TPTOUT	INCDAT	CLNUP	NOPM	TSIG	DETECT	TSTSAT	LANES	LSWCH	GETCD	HDWY	CFFRMP	GOQ	BLOK	CLOSE	SVEH	MOOV	CAL6	CAL5	CAL4	CAL3	CAL2	CAL1	COMMON Blocks
	X				X		X												X				X	X	X	X		A1
X	X	X		X		X	X									X				X			X	X				A2
		X							X											X			X	X	X	X	X	A3
						X	X																	X	X	X		A4
							X												X									A5
									X												X		X	X	X	X	X	A6
																				X								A7
X	X	X	X	X			X	X	X		X	X	X	X	X	X	X	X	X	X	X							A8
														X		X				X								A10
										X																		ACT0
										X																		ACT1
										X																		ACT4
										X																		ACT7
										X																		ACT10
										X																		ACT15
							X																					CFUEL
				X	X	X	X									X			X		X		X	X	X	X	X	CONTRL
						X																						CRASH
		X				X	X			X	X	X			X	X		X	X	X	X		X	X	X	X	X	ERTRAN
						X										X					X							FORINC
						X																						INCDMP
					X																							IPLTN
		X																			X							LASDCH
X	X	X	X	X					X		X	X	X	X	X	X	X				X							LENVI
																					X							NFILTS
							X																					NRGY
											X										X							ONVEH
						X																						RANK
X	X	X		X	X	X	X							X		X		X	X	X	X		X	X	X	X	X	SIZE
	X	X		X					X		X	X	X	X		X	X				X							SRFLAG
																								X	X	X		S1
				X	X	X	X		X	X	X	X	X			X	X		X	X	X		X	X	X	X	X	S2
	X		X		X		X		X	X	X	X	X	X		X	X			X	X							VBUF
																		X	X									VEER
			X	X					X		X	X	X	X		X	X				X							VENVI

Table 4: Subroutine - COMMON Block Cross Reference Chart (cont.)

SIFT Module Routines (Concluded)																														
SPOINT	SINC3	SINC2	SINC1	SINCES	INTST	CYCP	CPTOUT	FTSC	FILTST	RESET	INIT	LOCON	COLECT	ADVANC	CANCEL	LCROSS	RISK	CHECK	CHANGE	EMGNCY	CONSOL	FRESET	ONRMP	FGNRAT	FMOVE	FMAIN	REVEN	GETUNV	SEVEN	COMMON Blocks
					X	X	X	X	X	X	X	X	X	X	X	X		X	X		X	X	X	X		X				A1
	X	X	X		X	X		X	X	X	X					X			X				X		X	X				A2
														X									X		X					A3
X				X			X			X	X		X																	A4
																									X					A5
								X																X		X				A7
					X	X							X	X	X	X	X	X	X		X		X	X	X	X			X	A8
					X					X	X	X		X		X							X	X		X				A10
						X				X	X		X																	A11
										X																				CFUEL
X	X	X	X	X	X	X	X	X		X	X	X	X											X	X	X				CONTRL
X	X	X	X	X								X																		CRASH
	X																													DBLEXP
																								X		X			X	ERTRAN
												X	X	X		X							X		X					FORINC
																	X	X	X	X			X	X	X	X				FPAR
						X				X	X		X																	FREDAT
							X			X																				IPLTN
																													X	LENVI
									X	X	X					X														NFILTS
												X																		NIDTSV
										X	X																			NRGY
																							X			X				ONVEH
																			X							X				RANK
	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X		X	X		X	X	X	X		X				SIZE
																											X	X	X	SRFLAG
X	X	X	X		X	X	X	X		X	X	X		X									X		X	X			X	S2
								X				X																		S3
														X	X	X		X	X				X	X	X				X	VBUF
																							X							VEER
																											X		X	VENVI

Table 4: Subroutine - COMMON Block Cross Reference Chart (concl.)

Module Routines																																					
SAM				INPLOT														POSPRO	INCES													FUEL					
STAT	PRINT	READCL	SAM	TRAJEC	TPLOT	SPTAL	SEARCH	PATH	PAGE	LEGEND	IOPROC	FILEX	CPLOT	CONTR	COMPCT	AXPLOT	INPLOT	POSPRO	MOUT	TTIME	MOE3	MOE2	MOE1	PINC	INC3	INC2	INC1	POUT	POINT	READET	INCES	BDNOEM	BDCOEM	BDHCEM	BDFLCN	FUEL	COMMON Blocks
																					x	x	x					x			x						A1
																		x							x	x	x	x			x					x	A2
																			x	x	x	x	x	x				x	x		x						A4
																		x																			A8
																					x	x	x								x						AMD
																																x	x	x	x	x	BFUEL
																																				x	CFUEL
									x							x																					CHT
										x			x	x			x																				CNTR
			x	x		x			x		x	x		x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x					x	CONTRL
																			x	x	x	x	x	x	x	x	x	x	x	x	x						CRASH
				x	x			x	x	x			x	x		x	x																				CRD
																									x												DBLEXP
			x	x				x	x			x		x			x													x	x					x	ERTRAN
																															x						INCDMP
																									x	x	x				x						INCEST
				x		x		x	x		x			x		x	x																				IPERR
						x			x																												LANET
																					x	x	x						x								MTOC
																								x	x	x	x										NUMP
																				x	x	x	x						x		x						PDATA
				x	x	x	x	x	x		x	x	x	x	x	x	x																				PLT
																															x						RANK
																			x		x	x	x	x	x	x	x		x		x					x	S2
x	x	x	x																																		SAMP2
x	x		x																																		SAMP3
																		x			x	x	x		x	x	x	x			x					x	SIZE
				x	x		x							x	x		x																				T1
				x	x				x		x		x	x	x	x	x																				TMDAT
																				x	x	x	x														TRVTM

It is important to note that the individual size of each of the revised arrays does not exceed 15000 elements. In this case, we have the following final sizes for the various arrays:

Array	New Size
LNKF	14994
LNKR	14994
LNKS	14982
VF	14982
VR	15000
VS	15000

2.6.2 Change Maximum Number of Links

To revise the maximum total number of links of all types, the following procedure must be followed:

1) Change value of NTOTL in BLOCK DATA INTVAR to new maximum number of links.

2) Change size of arrays IVFEET and ENDNDS in all routines containing COMMON /A2/. Change size of arrays VPROC, MNUVR, LTRNV, THRUV, RTRNV and VCONT in all routines containing COMMON /A10/. Change size of IFRANK array in all routines containing COMMON /RANK/. Change size of LADISH array in all routines containing COMMON /LASDCH/. Change size of LIN array in COMMON /SAMP2/ and the size of DMAT and DMBT in COMMON /SAMP3/. Refer to Table 4.

3) In addition to changing link specific arrays in COMMON blocks, the following local arrays must be changed also:

Routines	Array	Size
POSPRO,SAM,READCL	IB	(8 x NTOTL)
POSPRO,SAM,READCL	IZ	(8,NTOTL)
FUEL	LBUF	(NTOTL,4,5)
FUEL	KDIST	(NTOTL,5)
FUEL	KFUELT	(NTOTL,5)
LRANK	LENTRY	(NTOTL)
LRANK	LTEMP	(NTOTL)

Routines	Array	Size
LRANK	LLEFT	(NTOTL)
INCDAT	LINKD	(NTOTL)
INCDAT	IBOUT	maximum of 21*NTOTL+1 or 3*NDET+10

2.6.3 Change Maximum Number of Nodes or Entry Links

To revise the maximum number of nodes or entry links, the following procedure must be followed:

1) Change value of NTOTN in BLOCK DATA INTVAR to new maximum number of nodes or entry links

2) Change size of SIGI array in all routines containing COMMON /A3/. Change size of SIG, NPHS and SIGT arrays in all routines containing COMMON /A6/. Change size of SNODE array in all routines containing COMMON /A7/. Refer to Table 4.

2.6.4 Change Maximum Number of Detectors

To revise the maximum number of detectors, the following procedure must be followed:

1) Change value of NDET in BLOCK DATA INTVAR to new number of detectors.

2) Change size of DTCTR array in all routines containing COMMON /A4/. Refer to Table 4.

3) Change size of IBOUT array in INCDAT to maximum of 3*NDET+10 or 21*NTOTL+1.

2.6.5 Change Maximum Number of Incidents

To revise the maximum number of incidents, the following procedure must be followed:

1) Change value of NINCI in BLOCK DATA INTVAR to new number of incidents

2) Change size of INCID array in all routines containing COMMON /A5/. Refer to Table 4.

2.6.6 Change Maximum Number of Actuated Nodes

To revise the maximum number of actuated nodes, the following procedure must be followed:

1) Change value of IANOD in BLOCK DATA INTVAR to new maximum number of actuated nodes.

2) Change size of IACPAR array in all routines containing COMMON /A6/. Refer to Table 4.

If the revision is to increase the number of intersection actuated traffic controlled nodes, the following procedure must be followed:

1) Change the value of MACR in BLOCK DATA INTVAR to new maximum number of intersection actuated traffic controlled nodes (MACR must be less than or equal to IANOD).

2) Change size of NAFZ, NAAFZ, NATMR, NADET, NADTM, NACNT, NALNK, NACDS, NACYC, NADEC, NASTAT, NEWDET and SIGA arrays in their respective COMMON blocks: /ACT1/, /ACT2/, /ACT3/, /ACT4/, /ACT5/, /ACT6/, /ACT7/, /ACT8/, /ACT9/, /ACT11/, /ACT12/, /ACT15/ and /ACT20/. Refer to Table 4.

2.6.7 Change Maximum Number of Freeway Statistical Data Stations

To revise the maximum number of freeway statistical data stations, the following procedure must be followed:

1) Change value of NSTATN in BLOCK DATA INTVAR to new maximum number of entries.

2) Change size of LSTATN array in all routines containing COMMON/A11/. Refer to Table 4.

2.7 Computer Requirements

The INTRAS model is written in standard FORTRAN as established by the American National Standards Institute (ANSI). INTRAS deviates from ANSI FORTRAN only in those areas where either the local computer operating system or compiler requires it or core storage or coding economies dictate it. INTRAS is developed for and implemented on the CDC 6600/7600 computer series under the SCOPE operating system and the IBM 360/370 computer series under OS/360. Since ANSI FORTRAN is used, the model may be implemented on virtually any large scale computer having an ANSI FORTRAN compiler. To accomplish this, those deviations from the standard mentioned above need be defined.

Since INTRAS is an overlayed program the means of achieving the overlay must be tailored to the individual operating system. CDC/SCOPE overlays are created by inserting delimiter "OVERLAY" cards in the deck. These cards exist in the CDC version of INTRAS preceding the routines; INTRAS, PORGIS, LIS, SIFT, HICON, LOCON, FUEL, INCES, POSPRO, INPLOT AND SAM. Each lower level overlay is entered via a "CALL OVERLAY" command in the immediate higher level overlay. Each overlay module under CDC/SCOPE has a main program which is begun with a "PROGRAM" card.

For IBM/OS the overlay structure is created by a linkage editor operation. This allows the IBM/OS FORTRAN to be standard ANSI. Under IBM/OS there is only one main program. The "PROGRAM" card is unnecessary as are "OVERLAY" delimiters and "CALL OVERLAY". Lower level overlays are referenced by standard FORTRAN subroutine CALLs.

The ANSI standard for FORTRAN "DATA" statements prohibits (or rather does not specifically endorse) implied "DO" loops and unsubscripted array names. To define large arrays of data without this convenience is both extremely voluminous (particularly in the case of the FUEL module)

and subject to transcription error. Large arrays in INTRAS requiring built-in data values rely on non-ANSI "DATA" statements. Such statements are located in the following routines: BLOCK DATA INTVAR, PRINT, STAT, TTEST, ANOVA, WILCOX, UTEST, BLOCK DATA BDFLCN, BLOCK DATA BDCOEM, BLOCK DATA BDNOEM, BLOCK DATA BEHCEM.

To achieve efficient storage of data in INTRAS, features of the specific CDC and IBM systems are used. The IBM 360/370 version of INTRAS makes use of the INTEGER*2 (half word integer variable) capability of IBM 360/370 FORTRAN. INTEGER*2 specifications are used for arrays in the COMMON blocks specified in Table 5. In addition, local variables in the subroutines specified in Table 6 are specified as INTEGER*2.

In the CDC 6600/7600 version of INTRAS, the INTEGER*2 specifications are carried as comment cards (column 1 contains the character "C"). To allow INTRAS to be run on a 64K word, small core memory (SCM) 6600 or 7600, the CDC large core memory (LCM) feature is employed. To invoke LCM, the variables in COMMON blocks SAMP3 and BFUEL are designated as "LEVEL 2" in the subroutines containing these blocks. This specification is unnecessary for 128K word CDC 6600/7600 systems.

Table 7 is a compilation of the data files used by INTRAS. The functional relationships of files which convey information between overlay modules are illsutrated in Figure 6. Files 8 through 11 and 13 through 25 are sequential files which may be assigned to local peripheral devices (either tape or disk). File 12 is a transport for conveying CALCOMP digital plotting information to an off-line CALCOMP plotter. It is assumed that the CALCOMP software routines FIN, PLOT, SYMBOL, NUMBER and PLOTS are available in the local software library.

Table 5: INTEGER*2 Arrays and Variables in COMMON for IBM Version of INTRAS

COMMON Block	Arrays and Variables Declared INTEGER*2
A1	NLV,LNKF,LNKR,LNKS,VF,VR,VS
A2	ENDNDS
A3	SIGI
A4	DTCTR
A5	INCID
A6	IACPAR,NPHS,SIGT
A8	CSTDCL,IPACK,ITPCT,LIMSPD,LNMNSP,MAXAC, TLNK
A10	LTRNV,MNUVR,RTRNV,THRUV,VCONT,VPROC
BFUEL	KCOEM,KFLCN,KHCEM,KNOEM
CRASH	IMMOE,INCALG,IPPT,KON,KPOINT,LENTHV,MAXCEL, MOEALG
LENVI	LACA,LACR,LCCR,LDHR,LDTR,LEXA,LFFR,LFTR, LLLA,LLNA,LLNR,LLOR,LLPA,LLTR,LMHR,LMTR, LPOA, LPOR,LPRA,LPRR,LRPA,LRTR,LSCA,LSHR,LSPA, LSPR,LSTR,LTCA,LTTR,LUVR,LVLR
ONVEH	IORG,IREN,IRV
RANK	IFRANK
SIZE	IS,IWDIND,IWDPAK,NWDS
VBUF	NF,NFA,NFL,NRA,NRL

Table 6: Local INTEGER*2 Arrays and Variables in Subroutines

Subroutine	Arrays and Variables Declared INTEGER*2
ULNKR,ULNKS	IWORD,JPARAM
UVR,UVS	IWORD,JPARAM
UNPAK,PAK	JPARAM
PLNKR,PLNKS	IWORD,JPARAM
PVR,PVS	IWORD,JPARAM
FINDLN	ICODE,LC,LPOS,LTEMP,LR27,L37,NLANE, NRLANE
NEXTLN	NEXL,LTEMP
LRANK	NEXTL,LTEMP,LENTRY
PORGIS	IDPOS
PRSIG	ICODE,ITURN,LP
CTPSV	LN,JPARAM
PRMSND,LPRMSN	ILANE
SURVIN,LSURVI	IFE,IPARM
INCIN,LINCIN	ICOD,LDAT
INACT,LINACT	LN
FLOOUT,LFLOOU	ILANE
INCOUT,LINCOU	IPTR
DETGEN,LDETGE	IDET2
LINKIN,LLINKI	BUFFER,ITMP
LINOUT,LLINOU	BUFFER,IL,LEN,ONOFF,OUTBUF
TURNIN,LTURNI	BUFFER
INT1,LINT1	BUF,BUFFER,ITMP
LIS	IDPOS,LENA,LENG,NAUX1,NAUX2,NLANE
LPRSIG	ICODE
LCTPSV	JPARAM
SIFT,MOEV,CHECK	IHAF
LASTLK	LTEMP
FRSTV	IHAF,LK,LN,MA
LASTV	LTYP,L3,MLT
UPSIG	IL,IQ,ISG,ISGN,JCF,NLANE
ASIG	JY
CAL1	IBASIC,METER
CAL2,CAL3	ISIG
CAL4	IBASIC,IHAF
CAL5	IHAF,JHAF
MOOV	IBASIC,IHAF,ISC,JHAF

Table 6: Local INTEGER*2 Arrays and Variables in Subroutines (continued)

Subroutine	Arrays and Variables Declared INTEGER*2
SVEH	I2,NEWV2
CLOSE	JPACK
OFFRMP	IHAF,KROSBF,LRV,NNF
HDWY	IDT,IVT,ITC
TSTSAT	IVT
DETECT	I1SIG,ICODE,IDIST,IIV,ILAN,ILINK,ISP, IVL,LAN,LEN
CLNUP	IHAF,MXI
INCDAT	IPACK2
TPTOUT	ICOD,ILOC,IV,IVL,LENA,LENE,NAUX1, NAUX2,NLANE
SELEN	IDUM,L,LC,LK,LA
FILL	LKNUM,LL,LTEMP
SEVEN	ICODE2,LDIS2,ML2,MSP2
GETUNV	IP2
REVEN	LTEMP2
FMOVE	IHAF,JHAF
FGNRAT	IHAF,JV
ONRMP	IHAF,ILKF,IPRF,IPSF,ISF,ILKL,JHAF, LANFOL,LRLEN,LRVPO,LRVSP
FRESET	LBUF,MQ
CHANGE	JHAF
LCROSS	IHAF,JDLANE,JHAF,KHAF,KROSBF,NNF
CANCEL	IHAF,JLF15,JLF18,JLL15,JLL18,JRF15, JRF18,JRL15,JRL18,NFX,NFY
ADVANC	IHAF,JHAF
COLECT	IAUXY,IS2,LINL,LOC1,LOC2,NUD
LOCON	KK
INIT,RESET	ITMP
FILTST	NE
FTSC	IHAF,ITSBUF
CPTOUT	KDET
CYCP	HDLAY2,HMOVE2,ICON2,ICYCF2, IHAF,IHSDL2,ILCHG2,IPCON2,IRPKT2, ISSDL2,IVOUT2,LANE2,LFPKT2,LNGTH2, SDLAY2,SMOVE2

Table 6: Local INTEGER*2 Arrays and Variables in Subroutines (concluded)

Subroutine	Arrays and Variables Declared INTEGER*2
INTST	ICODE,ICON,ICYCFL,IDLAYH,IDLAYT,IMOVEH, IMOVET,ISDLYH,ISDLYT,ISIGCD,IVDIS, LCHAN,LCHNG,LK
BDFLCN,BDHCEM	JB
BDCOEM,BDNOEM	JB
INCES	IPACK2

Table 7 : INTRAS File Identification

Fortran Logical File No.	Type	Function
5	Formatted	Card input
6	Formatted	Printer output
7	Formatted	Punch output
8	Formatted	Case Data file
9	Unformatted	INCES Data file
11	Unformatted	SAM Data file
12	Unformatted	Plotter Output Tape
13	Formatted	Intermediate Case Data Storage
14	Unformatted	Extra SAM file for editing
15	Unformatted	POSPRO utility file (subinterval)
16	Unformatted	INCDAT utility file
17	Unformatted	POSPRO utility file (cumulative)
19	Unformatted	INPLOT Data file
20	Unformatted	INPLOT utility file (trajectories)
21	Unformatted	INPLOT utility file (contours)
23	Unformatted	FUEL Data file
22, 24, 25	Unformatted	FUEL utility files

3. INTRAS CARD INPUT FORMATS

The following subsections identify and define the content of input cards read by the various program modules. Numeric data fields on all INTRAS data cards are "fixed point". This specification requires that numeric values be coded into the extreme right-most digits of these fields. This requirement is necessitated by the presence of an assumed decimal point immediately to the right of the numeric field. For example, the number "24" would be coded into a three digit field as "b24", where "b" indicates a blank space.

One card type, the Run Control Card, is read by the INTRAS Supervisor module to define the type of run and indicate the lower level module to be called.

Run Control Card - Type 99

Cols.	Description
1	1 = Last 99 card request 0 (blank) - Another request follows
2	1 = Diagnostic run 2 = Simulation run 3 = Diagnostic + simulation 4 = Off-line incident detection run 6 = Simulation + off-line incident detection 7 = Diagnostic + simulation + off-line incident detection run 8 = Table of contents for case data tape 0 (blank) = No diagnostic, simulation or incident detection (this would imply that Col. 24 will be specified, indicating an INPLOT or SAM run, or a stand alone FUEL run will be indicated by a "1" in column 27).
4 - 6	If Col. 2 = 2 or 6, then a data deck must be taken from the Case Data Tape. This field contains the sequence number of that data deck on the Case Data Tape.
7 - 9	As for Col. 4 - 6, if a data deck must be taken from the Case Data Tape, then this field contains the Run Identification number of that deck. (Col. 61-63 of Type 00 card.)

Both fields 4-6 and 7-9 may be specified concurrently or individually. If two decks on the Case Data Tape possess the same Run Identification number, then 4-6 must be specified. If the sequence number is not known, then the Run identification may be specified alone. If neither field is specified, then the case data must follow the 99 card in the input stream.

11	If this SIFT simulation is to produce output information on the Incident Data Tape, then this field should be set = (1,2) if the Incident Data Tape (does not, does) contain previously stored detector data. Otherwise, this column should be left blank.
12	If this SIFT simulation is to produce output information on the INPLOT Data Tape, then this field should be set = 1 if the INPLOT Data Tape is currently empty (i.e., no previous plot data sets have been stored on it). Otherwise, this column should be left blank.
14	If this diagnostic run (Col. 2 = 1, 3 or 7) data deck is to be stored on the Case Data Tape, this field must be specified as (1,2) if the Case Data Tape (does not, does) contain previously stored data decks. If the data deck is not to be stored, then Col. 14 - 0 (blank).
15	If the statistical results of this simulation run (Col. 2 = 2,3,6 or 7) is to be stored on the Statistical Data Tape for analysis by SAM, this field must be specified as (1,2) if the Statistical Data Tape (does not, does) contain previously stored data. If the statistical output is not to be stored, then Col. 15 = 0 (blank).
16 - 18	Incident detection data specification. If Col. 2 was specified = 4, then a previously stored set of data must be retrieved from the Incident Data Tape. The Run Identification number for that data must be entered in this field. Otherwise, leave this field blank.

21	For any incident detection run (Col. 2 = 4,6 or 7) this field should be specified as [0 (blank), 1] if a list of the Run Identification numbers for those incident data sets on the Incident Data tape (is not, is) to be produced. If the purpose of this 99 card is only to produce this Run Identification list, then Col. 2 should be specified as 4, Col. 3-18 should be blank, and Col. 21 should be 1.
24	To specify that this 99 card is a request for an (INPLOT, SAM) program run, this field should be set (1,2). This field should only be specified if Col. 2 - 21 are blank.
27	Code indicating FUEL run type: = 0, if FUEL module is to be run along with simulation = 1, if FUEL module is to be run using data previously written on FUEL Data Tape, no simulation (implies that column 2 = 0) ≥ 2, if simulation only, no FUEL module
30	Code (0,1) if exogenous FUEL data cards (are not, are) to be read in. If so, cards appear after last type 60 card for this case.
33	Code (0,1) if FUEL Data Tape (is, is not) to be written during this simulation.
36	Code (0,1) if FUEL data tables (are not, are) to be printed out. Tables are always printed if column 30 = 1.
79, 80	≡ 99 (card type identification)

3.1 Simulation Data Case Input Formats

The following cards are read by the PORGIS and LIS modules. Some cards may only be required and/or allowed for the first subinterval. Data cards for each simulation subinterval must occur in card type sequence in the data deck.

Simulation Title Card - Type 00 (One Permitted, First Subinterval Only)

Cols.	Description
1 - 60	Alphanumeric description of this run.
61 - 63	Three digit Run Identification Number. This number is used to identify output files for plotting, incident detection, and statistical analysis. Any runs which need be identified for future reference must be assigned a unique run identification.
65,66	Freeway Simulation Time step, in tenths of a second (i.e., 32=3.2 seconds). If left blank or zero, a default of 10 will be used. Must be specified as 10 for any off-line or on-line incident detection run.
67 - 69	Frequency at which lane change logic will be implemented in time steps. If left blank, a default of 2 will be used.
71 - 78	Seed for Random Number Generator. Must be odd and not a multiple of 5. If not specified, 7581 will be used.
79,80	$\equiv$00, card type.

Network Name Card - Type 01 (One Permitted, First Subinterval Only)

Cols.	Description
1 - 60	Alphanumeric description of network, data, etc.
63 - 66	Maximum length of initialization (network priming) period, in seconds.
68	Flag (=0,$\neq$0) if fill time (is not, is) to continue to maximum length even though equilibrium is reached.
69	Flag (=0,$\neq$0) if simulation (is not, is) to proceed if equilibrium (input$\approx$output) is not achieved during fill time.

Cols.	Description
72	Flag (=0,≠0) if statistics are to be (cumulative, subinterval specific).
73 - 74	Hrs. } Simulation
75 - 76	Min. } starting time
77 - 78	Sec. } on 24-hour clock
79,80	≡ 01, card type.

Link Geometry Cards - Type 02 (First Subinterval Only)

Data for exit links must not be specified on this card type, nor on any other link specific card type.

Cols.	Description
1 - 3	Node at upstream end of link. For entry LINKS this number must be (≥700, ≥800) for freeway, non-freeway) entries. Corresponding numbers in the 700 and 800 series may not be used (i.e., if 703 is used as the upstream node of a freeway entry, then 803 may not be used elsewhere in the network).
4 - 6	Node at downstream end of link.
8 - 11	Link length (feet). For urban links this distance is measured from stop line to stop line. Maximum length of freeway links is 9800 ft. The limit for ramp and surface links is 3265 ft. Not an input for entry links; a default value of 9825 will be used for freeway entries, 3275 for surface entries.
12	Link type, as follows: 0 (blank) or 1 ≡ Urban links (all non-freeway links which do not connect directly to freeway links). 2 ≡ Ramps (all non-freeway links which do connect directly to freeway links). 3 ≡ Freeway links.

Cols.	Description
13 - 14	Mean desired free-flow speed (mph). The mean speed of traffic under low enough density conditions such that speeds are freely chosen.
15	Number of thru lanes (maximum 5). This figure does not include turn pockets for urban links, or auxiliary lanes for freeway links. Maximum number of lanes for ramps is 2. Maximum number of lanes for surface links=5-number of turn pockets. (Freeway entry links cannot have auxiliary lanes.)
16 - 18	Grade, in ± percent.
19 - 21	Node at downstream end of link receiving left turning traffic from this link. Leave blank if link being defined (in columns 1-6) is an on-ramp.
22 - 24	Node at downstream end of link receiving through traffic from this link.
25 - 27	Node at downstream end of link receiving right turning traffic from this link. Leave blank if link being defined (in columns 1-6) is an on-ramp.

For entry ramps, only a thru receiving (freeway) link may be specified. For exit ramps, two movements, at most, may be specified, one of which must be thru. More complex turn movements from an exit ramp require the placement of a dummy node such that the downstream portion of the ramp may be classified as a surface link. For freeway links, a receiving link for thru movements must be specified plus, at most, one other right or left turn movement to a ramp link.

Network exit links are implicitly specified by setting the node numbers at the downstream end of links receiving the exiting traffic ($\geq$700, $\geq$800) for (freeway, non-freeway) exits. As specified in the column 1-3 description, corresponding numbers in the 700 and 800 series may not be used. An off-ramp may not be an implied exit link.

Cols.	Description
29 - 30	Location on this freeway link at which drivers begin to react to an upcoming exit or location where early warning sign becomes visible to the motorist; expressed as percent of link length measured from upstream node. 100% is not an allowable value. Signs located at the downstream extremity of a freeway link should be coded as positioned 0% on the succeeding link.
31 - 33	Node locating off-ramp, freeway junction referred to by early warning sign of columns 29-30.
40 - 72	Same as Cols. 1-33 for another links geometry.
79,80	≡02, Card Type.

Link Name Cards - Type 03 (First Subinterval Only - Optional)

Cols.	Description
1 - 3	Node at upstream end of link
4 - 6	Node at downstream end of link
7 - 24	Alphanumeric Link Name
25 - 48 49 - 72	Same as Cols. 1 - 24 for another link
79,80	≡03, Card Type

Freeway Link Operation Cards - Type 04
(First Subinterval Only)

Cols.	Description
1 - 3	Node at upstream end of freeway link ($\geq$700 for freeway entry link).
4 - 6	Node at downstream end of freeway link.
9 - 12	Radius of curvature, feet (0 or blank denotes a straight link).
13	Auxiliary Lane Code for First Auxiliary Lane (Freeway entry links cannot have auxiliary lanes.) =0 or blank: No auxiliary lane =1: Right hand acceleration lane =2: Right hand deceleration lane =3: Right hand full auxiliary lane (Lane Length = Link Length) =4: Left hand acceleration lane =5: Left hand deceleration lane =6: Left hand full auxiliary lane (Lane Length = Link Length)
14 - 18	Lane length (feet) for first auxiliary lane. An acceleration lane extends for the specified distance from the upstream node. A deceleration lane extends for the specified distance from the downstream node. This field need not be specified for code = 3 or 6. To facilitate

Cols.	Description
	the internal logic of SIFT, it is important to correctly categorize the type of auxiliary lane. A deceleration lane is defined as a lane which is not fed directly by a lane in an upstream freeway or ramp link. Its length should be less than the link length. An acceleration lane is defined as a lane which does not feed directly a lane in a downstream freeway or ramp link. Its length should also be less than the link length. Only lanes which connect directly with lanes in both up-stream and downstream links may be categorized as full auxiliaries.
19 - 24	Same as Cols. 13-18 for second auxiliary lane.
27	Identification of lane entered in through receiving link by vehicles in lane 1 of this link. If through movement is an exit link code a "1" in Col. 27. Lanes are identified as follows:

Lane	ID
Second Auxiliary Left Lane	7
First Auxiliary Left Lane	6
Lane 5	5
Lane 4	4
Lane 3	3
Lane 2	2
Lane 1 (Right-most thru lane)	1
First Auxiliary Right Lane	8
Second Auxiliary Right Lane	9

29, 30	Specification of lanes separated by physical barriers which prevent weaving. Insert the lane ID of the right hand lane of each such pair. Thus, two such conditions may be specified for each link.
31 - 32	Superelevation (percentage).
33	Pavement code: 1 - dry concrete; 2 - wet concrete; 3 - dry asphalt; 4 - wet asphalt Note: default is dry concrete.

Cols.	Description
36 - 39	Distance from upstream node of link for freeway data station (0 if no station), feet.
40 - 78	Same as Cols. 1-39 for another freeway link.
79,80	≡04, card type.

Ramp Link Operation Cards - Type 05

If any Card Type 5 is specified after the first subinterval, all variables which may change after the first subinterval should be specified to avoid confusion (e.g. Cols. 7,8-9).

Cols.	Description
1 - 3	Node at upstream end of ramp link.
4 - 6	Node at downstream end of ramp link.
7	"Type" of downstream intersection. Used as index of TLNK array to select appropriate distribution about mean queue discharge headway (default = 1).
8,9	Mean queue discharge headway in tenths of a second (i.e., 24=2.4 seconds). (This field is ignored for on ramps.)
12	Identification of lane entered in through receiving link by vehicles in lane 1 of this link. If through movement is an exit link, code a "1" in Col. 27. Lanes are identified as follows:

Lane	ID
Second Auxiliary Left Lane	7
First Auxiliary Left Lane	6
Lane 5	5
Lane 4	4
Lane 3	3
Lane 2	2
Lane 1 (Right-most thru lane)	1
First Auxiliary Right Lane	8
Second Auxiliary Right Lane	9

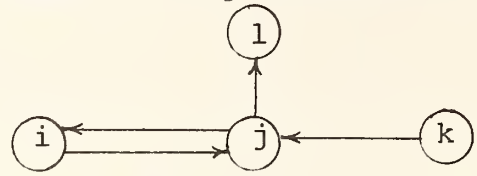
Cols.	Description
15 - 18	Radius of curvature (ft). 0 or blank for straight link. (May not be specified after first subinterval.)
19 - 20	Superelevation (%). (May not be specified after first subinterval.)
21	Pavement code: 1 - dry concrete; 2 - wet concrete; 3 - dry asphalt; 4 - wet asphalt. Note: Default is dry concrete. (May not be specified after first subinterval.)
40 - 60	Same as for Cols. 1-21 for another ramp link.
79,80	≡05, card type.

Surface Link Operation Cards - Type 06

If any card type 6 is specified after the first subinterval, all variables, which may change after the first subinterval, should be specified to avoid confusion (e.g., Cols. 7-12, 23-27).

Cols.	Description
1 - 3	Node at upstream end of urban link (≥800 for entry link).
4 - 6	Node at downstream end of urban link.
7	"Type" of downstream intersection (TLNK array index). Default = 1.
8,9	Mean queue discharge headway, in tenths of a second (i.e., 24 = 2.4 seconds).
11,12	Lost time for first vehicle in queue when signal becomes green, in tenths of a second (i.e., 21 = 2.1 seconds). If zero or blank, a default distribution will be used.

Cols.	Description
13 - 15	Upstream node of link whose thru traffic opposes left turning traffic from this link.



In the diagram link (k,j) opposes left turning traffic from (i,j). Therefore, k would be entered in Cols. 13-15 of the card type 06. Specification for link (i,j). If a link (j,k) exists which receives thru traffic from link (i,j) the model logic would automatically assume that the opposing link was (k,j) if it exists. Cols. 13-15 could be left blank for this case. (May not be specified after first subinterval.)

18 — Size of right turn pocket, in number of passenger cars $\left(\frac{\text{length}}{20\ \text{feet}} = \text{number of cars}\right)$. May not be specified after first subinterval.

21 — Size of left turn pocket in number of passenger cars (length/20=number of cars). May not be specified after first subinterval.

23 — Code denoting channelization of lane 1 (curb lane) on this link.

Code	Channelization
0 (blank)	Unrestricted
1	Reserved for left-turn vehicles
3	Closed for this subinterval
4	Reserved for right-turn vehicles

Note: Only one lane may be reserved for left turning vehicles and only one lane may be reserved for right turning vehicles.

24	Channelization code for lane 2 (if any).
25	Channelization code for lane 3 (if any).
26	Channelization code for lane 4 (if any).
27	Channelization code for lane 5 (if any).
40 - 66	Same as Cols. 1-27 for another link.
79,80	=06, card type.

Link Turning Movement Cards - Type 08

Cols.	Description
1 - 3	Node at upstream end of link.
4 - 6	Node at downstream end of link.
7 - 9	Percentage of vehicles turning left at downstream node.
10 - 12	Percentage of vehicles traveling through at downstream node.
13 - 15	Percentage of vehicles turning right at downstream node. For freeway links, turning percentage is applied only to vehicles entering subject link from an upstream freeway link. If an on-ramp enters the freeway at the upstream node of the subject link, all vehicles are assigned as through vehicles.
16 - 30 31 - 45 46 - 60 61 - 75	Same as Cols. 1-15 for other links.
79,80	≡08, Card Type.

Sign and Signal Control Cards - Type 10

One required for each node other than entry nodes ≥ 700, first subinterval only.

Cols.	Description
1 - 3	Node number
6	Actuated signal index. If the intersection is controlled by signing or fixed time signals then this field should be set = 0 or blank. If a precoded traffic activated control subroutine is to be called, then the index of that routine should be entered here. Subroutine UPSIG calls these routines as required.

The format of the remainder of this card (with the exception of Cols. 79, 80) depends on the contents of Col. 6.

Sign and Fixed Time Control Format (Col. 6 = 0)

7 - 9	Reference offset to Inverval 1, sec.(omit for sign control)
10 - 12	Upstream Node Number of approach link number 1
13 - 15	Upstream Node Number of approach link number 2
16 - 18	Upstream Node Number of approach link number 3
19 - 21	Upstream Node Number of approach link number 4

Cols.	Description
27	Control Code for signal facing approach link number 1 during Interval 1.

Code	Meaning
0	Yield sign or amber
1	Green
2	Red
3	Red with Green right arrow
4	Red with Green left arrow
5	Stop or Red with right turn permitted after stop
7	No turns - Green thru arrow
8	Red with left and right Green arrows
9	No left turn, Green thru and right

Cols.	Description
28	Control Code for signal facing approach link number 2 during Interval 1.
29	Control Code for signal facing approach link number 3 during Interval 1.
30	Control Code for signal facing approach link number 4 during Interval 1.
31 - 33	Duration of control Interval 1, seconds. (Stop or Yield sign or uncontrolled freeway node: Leave blank.)
36 - 42	Same as Cols. 27-33 for control Interval 2. (Only one interval is input for sign control.)
45 - 51	Same as Cols. 27-33 for control Interval 3 (if any).
54 - 60	Same as Cols. 27-33 for control Interval 4 (if any).
63 - 69	Same as Cols. 27-33 for control Interval 5 (if any).
72 - 78	Same as Cols. 27-33 for control Interval 6 (if any).
79,80	≡ 10, card type.

Actuated Control Format (Col 6 > 0)

7 - 9 10 - 12 13 - 15 . . . 76 - 78	Up to 24 parameter values may be specified which will be made available to the particular actuated control subroutine specified by the actuated signal index (Col. 6). A definition of these parameters for six ramp metering and freeway traffic diversion algorithms built in to INTRAS follows.
79,80	≡ 10, Card Type

The first four Actuated Control methods are reserved for on-ramp metering algorithms developed for INTRAS. For all four metering procedures, it is assumed that only one link approaches the node at which metering is applied. This node must be the upstream node of a ramp link. Figure 5 in Section 2.2.8.1 illustrates a typical on-ramp configuration. Metering may be applied at either node C or D in this configuration. If the signal is placed at Node D the ramp link would extend from Node D to B (C would not be required). The general metering procedure alternates some basic signal code (see codes as described for the card type 10 "Sign and Fixed Time Control Format"), with some other more permissive code at a rate established by the particular metering algorithm. For example, at node C a "Basic Code" of 2 (red signal) might be alternated with a "Metered" code of 1 (green signal). "Basic" and "Metered" codes applied at node D might be 7 (green for through movement) and 1 (green signal) respectively.

At the frequency dictated by the prevailing metering rate, the "Metered" code would replace the "Basic" code. A vehicle discharge triggers a return to the "Basic" Code. The contents of Card Type 10 for the ramp metering algorithms are as follows:

Clock Time Ramp Metering (Col 6 = 1)

Cols.	Description
1 - 3	Node number
6	≡ 1, code indicating clock time metering
7	"Basic" signal code
8	"Metered" signal code
9	Movement for which discharging vehicle triggers return to "Basic" signal code, as follows:

Code	Movement
0	Left-turn
1	Through
2	Right-Turn

12 - 15	Time for onset of clock time metering, in seconds from start of simulation
17, 18	Metering headway, seconds. Signal will be set to "Metered" code at this frequency
79, 80	≡ 10, card type

Demand/Capacity Ramp Metering (Col 6 = 2)

Cols.	Description
1 - 9	Identical to Clock Time Metering Format except that Column 6 ≡ 2 to indicate Demand/Capacity metering
10 - 12	Upstream node of freeway link containing detectors to be used in measuring freeway performance.
13 - 15	Downstream node of freeway link containing detectors to be used in measuring freeway performance
17	Lane containing first detector to be used in measuring freeway volume
18 - 21	Longitudinal position of detector in lane specified in column 17, in feet from upstream node (Col. 10 - 12). This field should be identical to the "Location" specified on the Type 25 (surveillance specification) card for this detector.
23 - 27 29 - 33 35 - 39 41 - 45 47 - 51 53 - 57	These fields identify other detectors on the referenced freeway link to be used in measuring freeway volume. The data format is identical to that of columns 17 through 21.

Cols.	Description
59 - 63	Capacity of freeway in vehicles per hour. The sum of volumes traversing the detectors specified in columns 17 through 57 will be compared to this "capacity" to determine a ramp metering headway based on excess capacity.
79, 80	≡ 10, card type

Speed Control Metering (Col 6 = 3)

Cols.	Description
1 - 15	Identical to Demand/Capacity Metering Format except that column 6 ≡ 3 to indicate Speed Control Metering
17	Lane containing detector to be used as indicator of freeway speed
18 - 21	Longitudinal position of detector in lane specified in column 17, in feet from upstream node (col. 10-12). This field should be identical to the "Location" specified on the Type 25 (Surveillance Specification) card for this detector.
23, 24	Speed threshhold, miles per hour
26, 27	Metering headway, seconds. Signal will be set to "Metered" code at this frequency if speed (as measured by detector identified in cols. 17 - 21) is below speed threshhold specified in cols. 23, 24.
29 - 33 35 - 39	As for cols. 23 - 27 for second and third speed criteria, if desired. Highest speed criteria must be specified first (i.e. in columns 23 - 27)
79, 80	≡ 10, card type

Gap Acceptance Merge Control (Col 6 = 4)

Cols.	Description
1 - 15	Identical to Demand/Capacity metering format except that column 6 ≡ 4 to indicate Gap Acceptance Merge Control.
17	Lane containing coupled loop detector to be used to measure speed and size of gap in freeway traffic and speed.
18 - 21	Longitudinal position of coupled loop detector in lane specified in column 17, in feet from upstream node (cols. 10 - 12). This field should be identical to the "Location" specified on the Type 25 (Surveillance specification) card for this detector
23, 24	Minimum acceptable gap, tenths-of-a-second
79, 80	≡ 10, card type

Actuated control methods 5 and 6 are reserved for freeway traffic diversion algorithms developed for INTRAS. Both methods make use of user specified "alternate" paths to which freeway vehicles are diverted. The contents of Card Type 10 for the traffic diversion algorithms are as follows:

Clock Time Diversion (Col 6 = 5)

Cols.	Description
1 - 3	Node number at diversion point on freeway. One freeway link must be the only approach to the specified node. Two links (1 freeway and 1 off-ramp) must depart from the specified node.
6	≡ 5, code indicating clock time diversion
9 - 12	Time for onset of clock time diversion, in seconds from start of simulation
14 - 15	Percent of through traffic to be diverted to alternate path

Cols.	Description
16 - 18 19 - 21 22 - 24 25 - 27 28 - 30 ⋮ 76 - 78	Nodes defining alternate path of diverted traffic. All nodes along path must be specified starting with the next node after that given in columns 1 - 3. The final node of the alternate path must be either a surface exit $\geq$ 800 or a freeway node at the downstream end of an on-ramp.
79,80	$\equiv$10, Card Type.

Least Time Path Diversion (Col 6 = 6)

For this method, use subinterval specific statistics (see Col. 72 on the type 01 card). The time evaluations are performed at the end of each subinterval and reflect the travel time for the latest subinterval. Diversion percentage will increase or decrease in increments of 5%, depending upon which route is the fastest.

Cols.	Description
1 - 3	Node number at diversion point on freeway. Defined as for clock time diversion.
6	$\equiv$6, code indicating least time path diversion
16 - 18 19 - 21 22 - 24 25 - 27 28 - 30 ⋮ 76 - 78	Nodes defining alternate path of diverted traffic. All nodes along path must be specified starting with next node after that given in columns 1 - 3. The final node of the alternate path must be either a surface exit $\geq$ 800 or a freeway node at the downstream end of an on-ramp.
79,80	$\equiv$10, Card Type.

Intersection Actuated Traffic Control (Col 6 = 7)

Nodes under intersection actuated traffic control should be described on a type 10 card as follows (implies that type 15, 16 and possibly type 17 cards will be input):

Cols.	Description
1 - 3	Node number where actuated controller is located
6	$\equiv$7, code indicating intersection actuated traffic control
79,80	$\equiv$10, Card Type.

Actuated Controller Card - Type 15

A separate input card type 15 must be punched for each actuated controller specified. The data on this card defines all links serviced and/or referenced by this controller. Up to six links may be specified. Generally, most (or all) of the specified links are approaches to the node at which the actuated controller is located. On occasion, one or more of these links may not be approaches to the node specified in Entry 1. These links which are approaches to the node specified in Entry 1 should be specified first, then followed by the other links, if any. Other characteristics of the controller are also specified on this card.

Entry	Cols.	Description
1	1-3	Node number of intersection controlled by an actuated signal controller
2	4-6	Upstream node number of approach number 1 which is serviced by this actuated controller
3	7-9	Downstream node number of approach number 1
4	10-12	Upstream node number of approach number 2 which is serviced by this actuated controller
5	13-15	Downstream node number of approach number 2 which is serviced by this controller
6	16-18	As for entry 2, but for approach number 3
7	19-21	Downstream node number of approach number 3
8	22-24	As for entry 2, but for approach number 4
9	24-27	Downstream node number of approach number 4.

Entry	Cols.	Description
10 11		Because card type 15 was adopted from the UTCS model version of card type 15, a change had to be made to omit references to approach 5 (INTRAS allows only four approaches to a node). Therefore, entries 10 and 11, which were nodes defining the fifth approach, should not be input.
12	34-36	As for entry 2, but for approach number 6.
13	37-39	Downstream node number of approach number 6.
14	40-42	As for entry 2, but for approach number 7.
15	43-45	Downstream node number of approach number 7.
16	48	Controller Coordination Code, CCC CCC = 0 if controller not coordinated CCC = 1 if controller is coordinated.
17	51	Red rest code: 0 if rest-in-red option not applied; 1 if it is applied.
18	52-54	Value of background cycle length (if CCC = 1).
19	57	Entry Code = 0 if single ring = 1 if dual ring and single entry = 2 if dual ring and dual entry.
20	60	Detector Switching Code = 0 if detector switching feature inactive = 1 if detector switching feature active.
21	79,80	≡ 15 card type.

Entry	Discussion
1	Node at which actuated controller is located.
2	Upstream node of approach number 1 which is serviced by, and/or referenced by, this controller
3	Downstream node of approach number 1
4,6,8, 12,14	Similar to entry 2 specifying the respective upstream nodes of approach numbers 2,3,4,6, and 7.
5,7,9, 13,15	Similar to entry 3 specifying the respective downstream nodes of approach numbers 2,3,4,6, and 7.
16	If CCC = 1, the following conditions must apply: a) This is a single-ring controller b) Phase 1 is non-actuated Hence, all coordinated controllers are single-ring controllers only.
17	The rest-in-red feature, if provided (code = 1), will terminate the active phase in the absence of traffic demand. If no calls are issued (i.e., there are no detector actuations and all recall switches are "off"), all phases will be inactive and display a red indication. If this feature is not provided (code = 0), the current active phase will remain active in the absence of a call from a competing phase.
18	All coordinated controllers (CCC=1), entry 16 are cycle-based. This entry is the value of the cycle length for this controller.
19	A dual-ring controller has to basic entry options: Single Entry (code = 1) Dual Entry (code = 2). Consider the case of a dual-ring controller. When a barrier is crossed, and one or more calls have been issued by a phase on only <u>one</u> ring, the response of the controller depends on its entry option. If a single-entry controller, only the

Entry	Discussion
	[first] called phase is activated; no phase on the other ring is activated. For the dual-entry option, the first phase beyond the barrier on the ring where no call was issued, will *also* be activated.
20	The detector switching feature is only available for dual ring controllers. This feature can become active under the following conditions: a) Two phases, one on each ring, must be active b) Both phases must be just prior to a barrier c) One phase (call it phase A) has "gapped out" or exceeded its maximum permitted duration, while the other (call it phase B) is still active. Note that since phases A and B are both at the barrier, both must terminate simultaneously. Since phase B is servicing a continuing demand, both A and B *must* be continued in an active status. When the detector switching feature is active, any subsequent actuations associated with phase A will be "switched" to phase B. That is, such actuations will be interpreted by the controller as having been generated by those detectors directly servicing phase B. If this feature is not available, the actuations associated with phase A will not contribute toward extending phase B and will serve no immediate control function at all.
21	Ths input, 15, must be punched (Card Type).

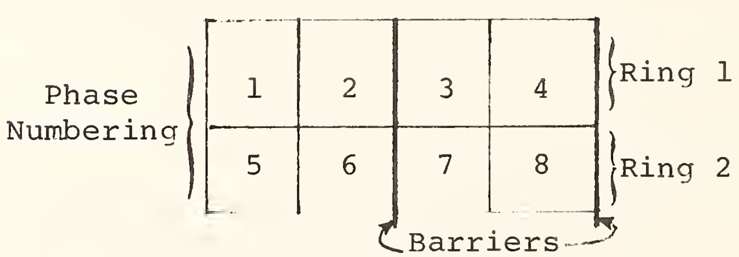
Phase Card - Type 16

Each phase on each actuated controller is defined by a separate input card type 16. The data on this card defines the operating characteristics of this phase.

	Entry	Cols.	Description
	1	1-3	Node Number
	2	6	Phase Number (1,2, ..., 8)
	3	9	Phase Actuation Code, PAC
Phase Non-Actuated	4	10-12	Yield Point - Beginning of Yield Interval, seconds
Phase Non-Actuated	5	13-15	End of Yield Interval, seconds
Phase Non-Actuated	6	16-18	Offset, seconds
Phase Actuated	4	10-12	Force-off Point, seconds
Phase Actuated	5	14-15	Minimum Initial Interval, seconds
Phase Actuated	6	18	Initial Interval Code, IIC
	7	20-21	Initial Interval Code, IID
	8	23-24	Initial Actuation Data, IAD
	9	26-27	Passage Time, tenths-of-a-second
	10	29-30	Minimum gap (unit extension), tenths-of-a-second
	11	32-33	Time to reduce to minimum gap, seconds
	12	35-36	The controller reduces the gap by the amount GG, every TT seconds. This entry is GG, tenths-of-a-second
	13	38-39	This is the time, TT, between reductions in gap, tenths-of-a-second

Entry	Cols.	Description
14	41-42	The gap (unit extension) is reduced by this amount (tenths-of-a-second) every second
15	44-45	Maximum Extension, seconds
16	47-48	Maximum Green, seconds
17	51	Amber Duration, seconds
18	54	Red Clearance Duration, seconds
19	57	Red Revert Time, seconds
20	60	Recall Switch Code
22	66	Inhibit Maximum Termination Code
23	69	Overlap Code
24	79,80	≡ 16 Card Type

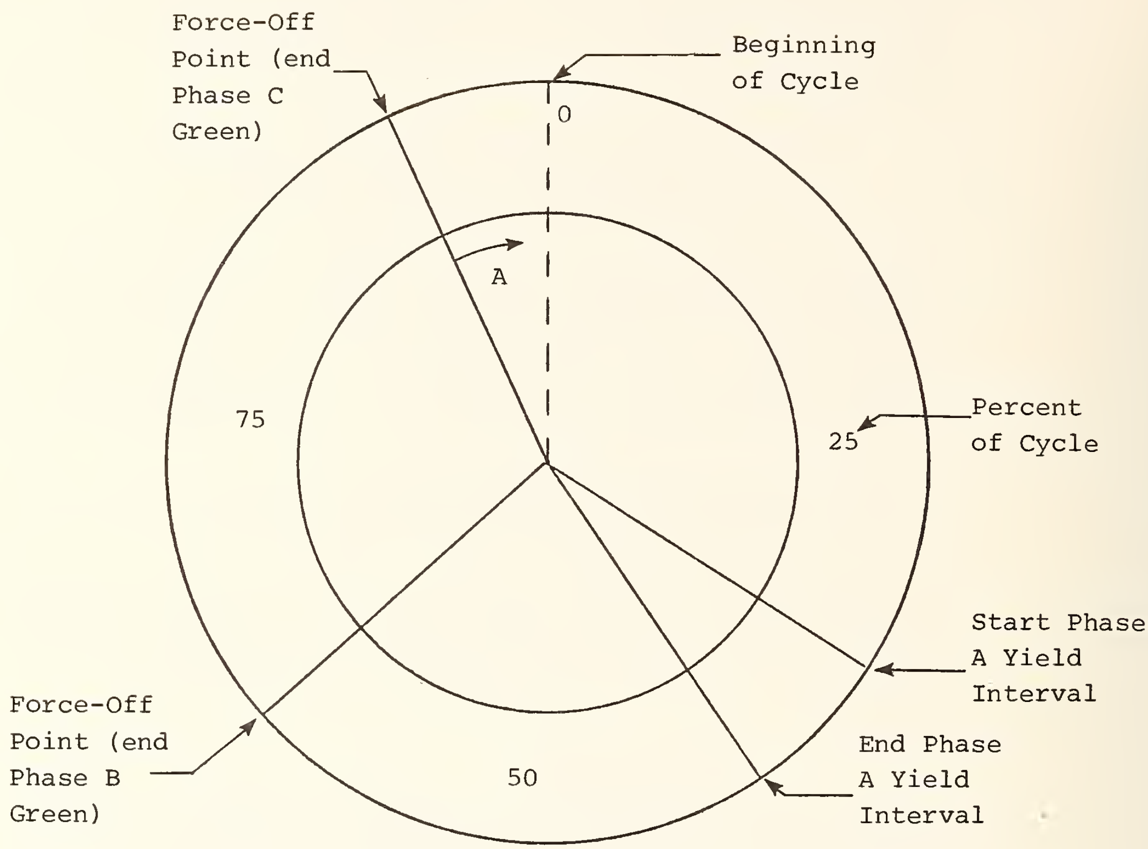
Entry	Discussion
1	Internal node number at which actuated controller is located.
2	Phase Number. If on Ring 1, it can be 1,2,3, or 4. If on Ring 2, it can be 5,6,7, or 8:



Entry	Discussion
3	The Phase Actuation Code, PAC, is set to 1 if this phase is not actuated; set to 0 if it is. An actuated phase must refer to at least one detector assigned to activate the Initial Interval.

Entries 4-6 If Phase Is Not Actuated and Controller is Coordinated

Entry	Discussion
4	The Yield Point is the beginning of the Yield Interval and marks the end of the time period during which a non-actuated phase cannot be terminated. The time period is measured from: • The beginning of the cycle if the controller is coordinated, i.e., CCC=1. If so, the non-actuated phase must be Phase 1. • The beginning of this phase if the controller is not coordinated, i.e., CCC=0. If a call has been issued by a competing actuated phase prior to the yield point, or if the recall switch of a competing phase is on, the non-actuated phase will be terminated at the yield point.
5	End of Yield Interval, measured as above. This input must be equal to or greater than that of Entry 4 (see Figure 7) for location of the yield interval). If, during the yield interval, a call is received from a detector servicing a competing phase, this phase will terminate. If, on the other hand, such a call is issued <u>after</u> the end of the yield interval, this non-actuated phase will remain active throughout the cycle.
6	Offset, if CCC=1 <u>and</u> this is Phase 1. Blank otherwise. If the controller is coordinated, only a single-ring controller is treated by this logic.



Notes: 1. Phase A is non-actuated, Phases B and C are actuated.

2. For each phase, specify its yield points or force-off point, in seconds.

3. For two-phase operation, there will be only one force-off point (located approximately at the position shown above for forcing-off Phase C green).

Figure 7: Yield and Force-Off for Coordinated Three-Phase Semi-Actuated Controller Operation

Entries 4-6 If Phase Is Not Actuated and Controller Is Not Coordinated

Entry	Discussion
4	Same as above. The Yield Interval extends indefinitely until a call is received from a competing actuated phase. At this time, the non-actuated phase is terminated.
5,6	Not applicable; leave blank. Note: all controllers with a non-actuated phase must be single-ring controllers only. If the phase is non-actuated, all of the following entries on this card <u>must</u> be blank with the exceptions of Entries 17, 18 and 24.

Entries 4-6 If Phase Is Actuated

4	Force-off Point is the point in time when an actuated phase must terminate. It is measured from the beginning of the cycle if controller is coordinated, CCC=1. Not applicable if controller is not coordinated (see Figure 7).
5	Duration of Minimum Initial Interval (MII), sec.
6	Initial Interval Code, IIC = 0,1,2, or 3 IIC = 0 if the initial interval is constant; its duration is specified in Entry 5 IIC = 1 if the "Added Initial" option is selected IIC = 2 if the "Computed Initial" option is selected IIC = 3 if the "Extensible Initial" option is selected. For the "Added Initial" option (IIC=1), the controller adds a specified amount of time (Entry 8) to the minimum initial interval (Entry 5) for every recorded actuation above a specified value (Entry 7). For the "Computed Initial" option (IIC=2), the controller computes the Initial Interval $\left(\frac{\text{Entry 7}}{\text{Entry 8}} \times \text{no. of recorded actuations}\right)$

Entry	Discussion
	subject to the specified minimum (Entry 5) and maximum (Entry 7) constraints. For the "Extensible Initial" option (IIC=3), the controller adds a specified amount of time (Entry 8) to the minimum initial interval (Entry 5) for every recorded actuation, subject to a specified maximum (Entry 7). These variations probably reflect the different hardware designs available in the field. They are included since each is represented in the NEMA specifications.
7	Initial Interval Data (IID) depends on the value assigned to IIC in Entry 6. IIC = 0, leave blank IIC = 1, this input is the number of actuations (vehicles) accumulated that can be serviced during the Minimum Initial Interval. Only if this number is exceeded will the controller provide added initial interval time IIC = 2 or 3, this input is the maximum initial interval, sec.
8	Initial Actuations Data (IAD) depends on the value assigned to the IIC in Entry 6. IIC = 0, leave blank IIC = 1 or 3, this input is the duration of the "added" initial time (tenths-of-a-second) to be added to the minimum initial interval for every vehicle actuation IIC = 2, this input is the number of actuations required to attain the maximum value of initial interval that is specified in Entry 7.
9	The (initial) passage time is the travel time for a vehicle to move from the detector through the intersection. It is also the maximum value of lane-specific inter-vehicular gap (unit extension) when the detectors for this controller are of the passage type.

Entry	Discussion
10	Minimum gap (unit extension), tenths-of-a-second is only applicable if the controller is of volume-density type. If so, then either a) Entry 11 must be specified <u>or</u> b) Entries 12 <u>and</u> 13 must be specified <u>or</u> c) Entry 14 must be specified. If neither a), b) or c) is specified, Entry 10 should be left blank, since there is no gap reduction for this controller.
11	This is the time over which the controller will reduce the unit extension from its maximum value (Entry 9) to its minimum value (Entry 10).
12,13	The user may specify that the gap (unit extension) may be reduced by a specified amount, GG, for every specified time interval, TT.
14	The rate per second that the gap (unit extension) is reduced, in tenths-of-a-second per second. Note: The following combinations of the prior five entries may be specified: 10 and 11; 10, 12 and 13; 10 and 14; none of these (10-14: blank). No other combinations are permitted; they would be redundant and possibly incompatible.
15	Maximum green extension is the maximum duration of "service green"; duration of green beyond the end of the initial interval.
16	Maximum green phase is the maximum duration of the sum of all green intervals: initial + added initial (if any) + service green. Note: <u>Either</u> Entry 15 <u>or</u> 16 may be specified--not both. The timer does not start until a call is received for a competing phase.
17,18 19	These are fixed interval durations.

Entry	Discussion
20	This code is set to zero if the recall switch is off; set to 1 if it is on. If the switch is on, this phase will always be activated by the controller in its turn. In this case, the phase duration will be at least the duration of the minimum initial interval, regardless of any vehicle actuations. If the switch is off, the phase can only be activated if a call is received via a detector actuation.
22	This code is only set to 1 when no upper bound is desired on <u>all</u> phases of this ring.
23	Overlap code indicates whether this phase overlaps the next one, the previous one, neither, or both: Code = 0, this phase overlaps no other = 1, this phase overlaps prior phase = 2, this phase is overlapped by the next phase = 3, this phase overlaps prior phase and is overlapped by the next phase. This code applies only for a single ring controller.
24	Must <u>always</u> be punched: 16.

Phase Operations Card - Type 17

These cards define the signal indications associated with the specified phase as well as the location of all detectors which provide actuations affecting the phase.

Entry	Cols.	Description
1	1-3	Node number at which actuated controller is located.
2	6	Phase Number.

Entry	Cols.	Description
3	9	Signal code identifying the signal indication servicing approach number 1 on card type 15 during this phase.
4	12	As for Entry 3, for approach number 2.
5	15	As for Entry 3, for approach number 3.
6	18	As for Entry 3, for approach number 4.
7		Because card type 17 was adopted from the UTCS model version of card type 17, a change had to be made to omit references to approach 5 (INTRAS allows only four approaches to a node). Therefore, Entry 7, which was signal code for the fifth approach, should not be input.
8	23	Approach number as specified on card type 15 identifying the detector located in the next entry.
9	24	Lane of link specified in Entry 8 which contains this detector. Actuations of this detector issue calls for this phase when it is <u>inactive</u>. This detector is assumed to be 60 feet from the stop line.
10,11	26,27	As for Entries 8,9 for another detector.
12,13	29,30	As for Entries 8,9 for another detector.
14,15	32,33	As for Entries 8,9 for another detector.
16,17	35,36	As for Entries 8,9 for another detector.
18,19	38,39	As for Entries 8,9 for another detector.
20,21	41,42	As for Entries 8,9 for another detector.
22,23	44,45	As for Entries 8,9 for another detector.

Entry	Cols.	Description
24	47	Approach Number identifying detector located in the next entry.
25	48	Lane of link specified in Entry 24 which contains the detector which times the arrival of vehicles, <u>relative to the unit</u> extension. Actuations of this detector issue call for this phase when it is <u>active</u>. If there is more than one detector in lane, it is assumed to be the one farthest upstream.
26,27	50,51	As for Entries 24,25 for another detector.
28,29	53,54	As for Entries 24,25 for another detector.
30,31	56,57	As for Entries 24,25 for another detector.
32,33	59,60	As for Entries 24,25 for another detector.
34,35	62,63	As for Entries 24,25 for another detector.
36,37	65,66	As for Entries 24,25 for another detector.
38,39	68,69	As for Entries 24,25 for another detector.
40	79,80	$\equiv$ 17 card type.

Entry	Discussion
1	Self-explanatory.
2	This is the subject phase.
3	Signal code which defines the signal indication provided by this phase servicing Approach No. 1 (Entries 2 and 3 on card type 15).

Entry	Discussion
4,5,6	Similar to Entry 3. The relevant links are those identified as Link Nos. 2,3 and 4, respectively, on card type 15.
8	This entry defines the approach number (1,2, ..., 7) identified on card type 15 which locates the detector referenced in Entry 9.
9	This entry defines the lane in which a detector is located that services this phase when it is <u>inactive</u>. This detector is located on the approach identified in Entry 8. As such, the vehicle actuations sensed by this detector are aggregated by the logic for the purpose of: 1) Issuing a "call" for this phase 2) Calculating the duration of the initial interval. The Link No. of Entry 8 corresponds to the link sequencing defined on card type 15.
24,25	This pair of entries defines the location (link and lane) of a detector that services this phase when it is active. As such, the vehicle actuations sensed by this detector are processed to calculate inter-arrival gaps. The Link No. of Entry 24 corresponds to the link sequencing defined on card type 15.
40	The input 17 must be punched.

Volume Card - Type 20

Cols.	Description	
1 - 3	Node at upstream end of link. This Node number must be ≥ 700.	
4 - 6	Node at downstream end of link.	
8 - 12	Flow rate expressed in veh./hr.	
13 - 15	% of vehicle Type 2	high performance passenger car
16 - 18	% of vehicle Type 3	intercity bus
19 - 21	% of vehicle Type 4	heavy single unit truck
22 - 24	% of vehicle Type 5	trailer truck
	The balance of vehicles not assigned to vehicle Type 2 through 5 will be considered as Type 1, low performance passenger cars.	
26 - 27	% of vehicles assigned to Lane 2	
28 - 29	% of vehicles assigned to lane 3	
30 - 31	% of vehicles assigned to lane 4	
32 - 33	% of vehicles assigned to lane 5	
	The balance will be assigned to lane 1. If all the above fields are blank, then vehicles will be distributed evenly across all lanes (not including auxiliary lanes). Cols. 26-33 are not an input for surface entries.	
40 - 72	Same as Cols. 1-33 for another link	
79, 80	≡20 Card Type	

Surveillance Specification Cards - Type 25

(Not for entry links. First subinterval only.)

Cols.	Description
1 - 3	Node at upstream end of link
4 - 6	Node at downstream end of link
7 - 11	Location of detector expressed as distance of downstream end of detector (downstream detector for coupled pair) from upstream node, in feet, or acquisition point for doppler radar
12	Detector Type Code
13, 14	Effective loop length (feet). Each loop of a coupled pair has the same effective loop length. This field is ignored for doppler radar detectors
15	Lane code of detector.

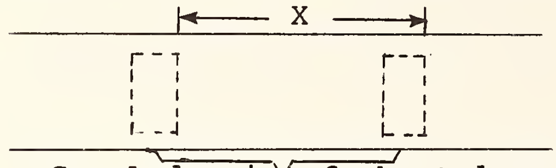
Detector Type Code (Col. 12):

Code	Detector
0	Doppler Radar
1	Short Loop
3	Coupled pair of short loops

Lane code of detector (Col. 15):

Code	Lane
1	1
2	2
3	3
4	4
5	5
6	First auxiliary left lane of left turn pocket
7	Second auxiliary left lane
8	First auxiliary right lane or right turn pocket
9	Second auxiliary right lane

Cols.	Description
17,18	Distance, X, separating coupled pairs of short loops, in feet, measured as shown below. This field is ignored for other type detectors.



Coupled pair of short loops

Cols.	Description
19 - 30 31 - 42 43 - 54 55 - 66	Same as Cols. 7-18 for other detectors on this link.
68,69	Station number for detectors input on this card (≤ 50). If left blank, no station number will be assigned to this (group of) detector(s). If it is desired to assign different station numbers for other detectors on this link, they should be input on another type 25 card. If more than five detectors on this link are to be assigned the same station number, they should be input on another type 25 card with the same station number in Cols. 68-69.
79,80	≡25, card type.

Note: More than one of these cards may be specified for each link.

Incident Specification Cards - Type 30 (freeway links only)

All incidents for all subintervals should be input with the first subinterval data. See discussion which follows the card format description for recommended incident generation procedures.

Cols.	Description
1 - 3	Node at upstream end of link
4 - 6	Node at downstream end of link
7	Incident Code for Lane 1

Code	Effect
0	Normal speed
1	Traffic capacity reduced at point of incident by amount specified by "rubber neck" factor
2	Blockage at point of incident

Cols.	Description
8	Incident Code for Lane 2
9	Incident Code for Lane 3
10	Incident Code for Lane 4
11	Incident Code for Lane 5
12	Incident Code for first left auxiliary lane
13	Incident Code for second left auxiliary lane
14	Incident Code for first right auxiliary lane
15	Incident Code for second right auxiliary lane
17 - 21	Longitudinal location of upstream end of incident in feet from upstream node.
22 - 24	Length of roadway affected by incident, feet

26 - 30	Time of onset in seconds measured from the start of simulation
33 - 36	Duration of incident, seconds
37 - 39	Rubberneck Factor. % reduction in capacity at point of incident for vehicles in lanes with Incident codes = 1
40 - 78	Same as Col. 1 - 39 for another incident
79, 80	≡ 30, Card Type

The user should follow certain basic rules in coding an idealized blockage type incident.

First, the length of roadway blocked should be determined. In general, the number of vehicles involved plus 1, multiplied by a nominal vehicle length (20 feet), is a reasonable predictor of affected roadway length. For example, a two vehicle collision would be well represented by a 60-foot blockage.

Second, rubbernecking should be specified for the non-blocked lanes. A rubberneck factor of 10% has been shown to be appropriate in simulation of Los Angeles incident data sets.

Third, a secondary incident, consisting of rubbernecking only, should extend downstream from the primary incident. The length of roadway affected should be the same as for the primary incident.

Embedded Data Change Card Formats: Card Types 35 through 49

To reduce to a minimum the total volume of input coding which must be prepared and coded by the user, certain values are incorporated directly into the model. Provision is made for convenient updating of these inputs by the user if he feels that it is necessary. The following fifteen types are for input of changes to the INTRAS embedded calibration data. The program variable names are used here as descriptors. See Appendix C for detailed description.

Card Type 35

Cols.	Description
3	Index of JMPG array, I $\leq$ 5.
4 - 6	JMPG(I).
9 - 12 15 - 18 21 - 24 27 - 30	Same as Cols. 3-6 for other elements of JMPG array to be changed.
31 - 33	ILT; leave blank for no change.
34 - 36	IRT; leave blank for no change.
37 - 39	IALAG; leave blank for no change.
42	Index of JERK array, I $\leq$ 5.
43 - 45	JERK(I).
48 - 51 54 - 57 60 - 63 66 - 69	Same as Cols. 42-45 for other elements of JERK array to be changed.
79 - 80	$\equiv$35, Card Type.

Card Type 36

Cols.	Description
3	Index of SPLPCT array, I $\leq$ 4.
4 - 6	SPLPCT(I).
9 - 12 15 - 18 21 - 24	Same as Cols. 3-6 for other elements of SPLPCT array to be changed.
27	Index of CLEN array, I $\leq$ 5.
28 - 30	CLEN(I)
33 - 36 39 - 42 45 - 48 50 - 54	Same as Cols. 27-30 for other elements of CLEN array to be changed.
79, 80	$\equiv$36, card type.

Card Type 37

1 - 3 4 - 6 7 - 9 . . . 28 - 30	Elements of LSLAG array; LSLAG(1) through LSLAG(10). If any are entered, all must be included.
31 - 33 34 - 36 . . . 58 - 60	Elements of ITGAP array; ITGAP(1) through ITGAP(10). If any are entered, all must be included.
79, 80	$\equiv$37, card type.

Card Type 38

Cols.	Description
1 - 3 4 - 6 7 - 9 . . . 28 - 30	Elements of IAMBR array; IAMBR(1) through IAMBR(10). If any are entered, all must be included in ascending order.
31 - 33 34 - 36 37 - 39 . . . 58 - 60	Elements of IGAP array; IGAP(1) through IGAP(10). If any are entered, all must be included in descending order.
79, 80	≡38, card type.

Card Type 39

3	Index of IGRVAL array, I ≤ 5.
4 - 6	IGRVAL(I)
9 - 12 15 - 18 21 - 24 27 - 30	Same as Cols. 4-6 for other elements of IGRVAL array to be changed. Note: Elements of IGRVAL must be in ascending order.
33	Index of MINAC array, I ≤ 5.
34 - 36	MINAC(I)
39 - 42 45 - 48 51 - 54 57 - 60	Same as Cols. 33-36 for other elements of MINAC array to be changed.
79, 80	≡39, card type.

Card Type 40

Cols.	Description
1 - 3 4 - 6 . . . 28 - 30	Elements of VFH array; VFH(1) through VFH(10). Must sum to 1000, ascending order. If any are entered, all must be included.
31 - 33 34 - 36 . . . 58 - 60	Elements of VFHF array; VFHF(1) through VFHF(10). Must sum to 1000, ascending order. If any are entered, all must be included.
79, 80	≡40, card type.

Card Type 41

3	Index of TLNK array, I $\leq$ 9.
4 - 6 7 - 9 . . . 31 - 33	Elements of TLNK array; TLNK (I,1) through TLNK(I,10). Must sum to 1000. If any are entered, all must be included
34 - 36	TLNK(I,21); leave blank for no change.
37 - 39	TLNK(I,22); leave blank for no change.
40 - 42	TLNK(I,23); leave blank for no change.
43 - 45	TLNK(I,24); leave blank for no change.
46 - 48	TLNK(I,25); leave blank for no change.
49 - 51	TLNK(I,26); leave blank for no change.
79, 80	≡41, card type.

Card Type 42

Cols.	Description
3	Index of TLNK array; I $\leq$ 9.
4 - 6 7 - 9 . . . 31 - 33	Elements of TLNK array; TLNK(I,11) through TLNK(I,20). If one is entered, all must be included.
79, 80	≡42, card type.

Card Type 43

3	Index of FOLK array; I $\leq$ 10
4 - 6	FOLK(I)
9 - 12 15 - 18 21 - 24 27 - 30 33 - 36 39 - 42 45 - 48 51 - 54 57 - 60	Same as Cols. 3-6 for other elements of FOLK array to be changed.
79, 80	≡43, card type.

Card Type 44

3	Vehicle type index of LIMSPD array; I $\leq$ 5.
4 - 6	Grade code index of LIMSPD array; J $\leq$ 4.
7 - 9	LIMSPD(I,J)

Card Type 44 - continued

Cols.	Description
10 - 18 19 - 27 28 - 36 37 - 45 46 - 54 55 - 63 64 - 72	Same as for 1-9 for other elements of LIMSPD array to be changed
79 - 80	≡44, card type.

Card Type 45

1 - 3	Vehicle type index of MAXAC array, I ≤ 7 Note: for I = 1 or 2, input freeway accelerations for autos for I = 6 or 7, input non-freeway accelerations for autos (types 1 and 2)
4 - 6	Grade index of MAXAC array, J ≤ 5.
7 - 9	Speed index of MAXAC array, K ≤ 5.
10 - 12	MAXAC (I,J,K)
13 - 24 25 - 36 37 - 48 49 - 60 61 - 72	Same as Col. 1-12 for other elements of MAXAC array to be changed.
79 - 80	≡45, card type.

Card Type 46

Cols.	Description
1 - 3	Vehicle type index of CSTDCL array, $I \leq 5$
4 - 6	Speed index of CSTDCL array, $J \leq 3$
7 - 9	CSTDCL (I,J)
10 - 18 19 - 27 28 - 36 37 - 45 46 - 54 55 - 63 64 - 72	Same as 1-9 for other elements of CSTDCL array to be changed
79 - 80	≡46, card type.

Card Type 47

1 - 3	Total number of lanes (section width) $2 \leq I \leq 5$
4 - 6	LNMNSP (I-1,1) Value for Lane 1 of I
7 - 9	LNMNSP (I-1,2) Value for Lane 2 of I
10 - 12	LNMNSP (I-1,3) Value for Lane 3 of I
13 - 15	LNMNSP(I-1,4) Value for Lane 4 of I
16 - 18	LNMNSP (I-1,5) Value for Lane 5 of I
19 - 36 37 - 54 55 - 72	Same as columns 1-18 for another section width of LNMNSP to be changed

If one value is changed then all values for that section width must be changed (must sum to I*100)

Card Type 48

Cols.	Description
1 - 3	Total number of lanes (section width) $2 \leq I \leq 5$
4 - 6	ITPCT (I-1,1) % commercial vehs. in lane 1
7 - 9	ITPCT (I-1,2) % commercial vehs. in lane 2
10 - 12	ITPCT (I-1,3) % commercial vehs. in lane 3 (if $I \geq 3$)
13 - 15	ITPCT (I-1,4) % commercial vehs. in lane 4 (if $I \geq 4$)
16 - 18	ITPCT (I-1,5) % commercial vehs. in lane 5 (if $I \geq 5$)
19 - 36 37 - 54 55 - 72	Same as columns 1-18 for another section width of ITPCT array to be changed
	If one value is changed, than all values for that section width must be changed. The values for each section width must sum to 100.
79 - 80	$\equiv$ 48, card type.

Card Type 49

Cols.	Description
3	Index of IFCOEF, $I \leq 9$
4 - 6	IFCOEF(I)
9 - 12 15 - 18 21 - 24 27 - 30 33 - 36 39 - 42 45 - 48 51 - 54	Same as 3-6 for other elements of IFCOEF array to be changed
55 - 57	Amount of time to complete a lane-change maneuver in tenths-of-a-second.

Cols.	Description
58 - 60	Minimum separation in tenths-of-a-second for generation of freeway vehicles.
61 - 63	Lane change probability in percent.
64 - 66	Minimum non-emergency freeway acceleration in tenths of a foot per second per second.
67 - 69	Percent of drivers desiring to yield right of way.
70 - 72	Lag to accelerate in tenths of a second.
73 - 75	Lag to decelerate in tenths of a second.
	Note: For Cols. 55-75 any blank or zero fields will be ignored and default values will be preserved.
79,80	≡49, card type.

Output of Simulation Vehicle Trajectory Card - Type 50

(Only one of these cards is allowed per SIFT simulation. It must be included with the first subinterval data.) The model will output the requested data on the INPLOT data tape for subsequent treatment by the INPLOT module.

Cols.	Description
1-3	Time step at which vehicle positions will be output, sec. This value must be greater or equal to the simulation time step specified on the Type 00 card.
7 - 9 10 - 12 16 - 18 . . . . . 76 - 78	These fields contain the sequence of nodes, describing the roadway section for which trajectory data is to be output. Each consecutive pair of nodes must represent a freeway link. If two (or more) non-contiguous roadway sections are to be stored, then a zero (or blank) field should be left between the sequences. Plots are not automatically generated by virtue of the data specified on these cards. They only serve to specify which data is to be retained.
79, 80	≡ 50, Card Type

Output of Simulation Contour MOE Card-Type 51

(Only one of these cards is allowed per SIFT simulation. It must be included with the first subinterval data.) The model will output the requested data on the INPLOT data tape for subsequent treatment by INPLOT.

Cols.	Description
1 - 3	Time step at which MOE data will be output, minutes
4 - 6	Spacing for contour MOE evaluations, feet. (Minimum = 100). The model will generate detectors, throughout the roadway sections of study, at the specified spacing. The basic MOE values will be stored on the INPLOT data tape for each detector station at the frequency dictated by the time step (Col.1-3).
7 - 9 10 - 12 13 - 15 16 - 18 . . 76 - 78	These fields contain the sequence of nodes describing the freeway section for which MOE contour data is to be output. If two (or more) non-contiguous roadway sections are to be stored, then a zero (blank) field should be left between the respective node sequences. Plots are not automatically generated by virtue of the data specified on these cards. They serve only to specify which data is to be retained.
79,80	≡ 51, Card Type

On-line Incident Detection Specification Card - Type 55

(Only one of these cards is permitted per SIFT simulation. It must be included with the first subinterval data.)

Cols.	Description
1 - 3	Polling frequency (number/sec.) for digital detectors only. Default value = 10.
4 - 6	Analog/digital flag 0 digital mode 1 analog mode
7 - 12	Evaluation frequency for incident detection expressed as number of freeway time steps between re-evaluations. Note: If on-line incident detection is desired, a freeway time step of 10 tenths-of-a-second must be specified in Cols. 64-66 of card type 00.
22 - 24	Number of parameters to be input on type 56 card for incident detection algorithm specified in Col. 75 of the type 56 card. Must be $\leq$18.
56,57	Assumed average vehicle length for incident detection, feet.
79,80	≡55, card type.

On-line Incident Detection Algorithm Parameter Card - Type 56

Up to two type 56 cards may be input for each incident detection algorithm indicated on card type 55; parameters 1-9 on the first and 10-18 on the second. Parameters for each incident detection algorithm must start on a new type 56 card. Table 8 presents samples of the incident detection parameters.

Cols.	Description
1 - 8 9 - 16 ⋮ 65 - 72	Parameters (in floating point) for algorithm specified in Col. 75.
75	Incident detection algorithm to be applied (≤ 3). If two type 56 cards are input for this algorithm, the second need not specify an algorithm number in this column.
79,80	$\equiv$56, card type.

On-line Incident Detection Detector Station Identification Card

Up to two type 57 cards may be input.

Cols.	Description
1 - 3 4 - 6 ⋮ 73 - 75	Station numbers to be used for incident detection. Must be input in upstream to downstream order. If there are two or more disconnected freeway sections, the station number sequences representing these sections must be separated by a zero.
79,80	$\equiv$57, card type.

Table 8: Incident Detection Parameter Definitions and Examples

Parameter Number	ALGORITHM 1 (Ref. 4)	ALGORITHM 2 (Ref. 9)	ALGORITHM 3 (Ref. 8)
1	Threshold of occupancy difference across successive sensor positions (8.0*)	Number of compression wave suppression periods (2.0)	$P_1 = (1,2)$ The occupancy feature to be used: $P_1=1$, Change in occupancy between sensor positions $P_1=2$, Percent change in occupancy over time
2	Threshold of percent occupancy difference across successive sensor positions (50.0)	T_1, Threshold of occupancy difference across successive sensor positions (13.0)	P_2, Exponential smoothing coefficient (from zero to one)
3	Threshold of percent occupancy difference at the downstream sensor over time (8.0)	T_2, Threshold of percent occupancy change at the downstream sensor over time (-30.0)	P_3, The incident threshold value (5.0)
4		T_3, Threshold of percent occupancy difference across successive sensor positions (31.0)	P_4, Absolute deviate smoothing coefficient (0.0,1.0)
5		T_4, Threshold of occupancy at the downstream sensor position (16.0)	
6		T_5, Another threshold of occupancy at the downstream sensor position (30.0)	

*Representative values of the parameters are given in parentheses. The user should input values appropriate to the given problem. See the indicated references for details.

Simulation Control Card - Type 60

One of these cards is required as the final card of each simulation sub-interval data.

Cols.	Description
3 - 6	Duration of subinterval, seconds (Minimum=10)
7 - 9	Time interval for print of cumulative (or subinterval specific) statistical output (seconds). Statistics (output tables) will be printed at the end of each subinterval and at the frequency specified by this field, during the subinterval.
10 -15	Time interval (seconds) for print of intermediate output. If information on current queuing, channelization, assigned turn movements, and occupancy is desired, then this field should be specified. Otherwise, leave blank.
16 - 21	Time of first intermediate printout, in seconds, from start of subinterval.
22 - 27	Time span, seconds, during which intermediate printout will be produced at frequency specified in Col. 10 - 12.
30	Code = (0,1) if this (is, is not) the last subinterval for the simulation run data deck.
79, 80	≡ 60 Card Type

3.2 FUEL Module Data Input Formats

The following cards are read by FUEL to change embedded FUEL data. Submit card type 1 (and, optionally, card type 2) for each set of values to be changed for a given data type (i.e., fuel consumption, hydrocarbons, carbon monoxide and oxides of nitrogen emissions), vehicle type and speed. The sequence of the FUEL data cards should be card type 1 and, if necessary, its corresponding card type 2 followed by the next type 1 card and its type 2 card. If a FUEL type 2 card is submitted, a type 1 card must also be submitted. A blank delimiter card follows the last FUEL data card. All FUEL data cards follow the last type 60 card for a simulation case data deck or the 99 card for a stand alone FUEL run.

FUEL Exogenous Data Cards

Card 1:

Columns	Contents
1 - 4	Data value for -9 fpss.
5 - 8	Data value for -8 fpss.
.	
.	
72 - 76	Data value for +9 fpss.
77	Data type code: 1 Fuel consumption 2 HC 3 CO 4 NOX
78	Vehicle type: 1 Low performance auto 2 High performance auto 3 Intercity bus 4 Heavy single unit truck 5 Trailer truck
79,80	Speed, fps.

Card 2 (Optional):

Submit this card to specify non-zero values for accelerations of +10 to +12 fpss. for vehicle types 1 and 2.

Columns	
1-4	Data value for +10 fpss
5 - 8	Data value for +11 fpss
9 - 12	Data value for +12 fpss
77 - 80	Must be identical to columns 77-80 of card type 1

FUEL Delimiter Card:

The delimiter card is one completely blank card.

3.3 INCES Module Data Input Formats

If the INCES module is called a type 65 card must occur in the data deck as the first INCES module data card. This card is followed by a number of type 66 cards if incident detection is specified. MOE estimation requires a type 67 card. Finally, if incident detection or MOE estimation is specified, the type 68 cards conclude the input.

Off-line Incident Detection, Point Processing and MOE Estimation Specification Card - Type 65

(Only one of these cards is permitted)

Cols.	Description
1 - 3	Polling frequency (number/sec.) for digital detectors only. Default value = 10.
4 - 6	Analog/digital flag 0 digital mode 1 analog mode
7 - 12	Evaluation frequency for MOE estimation and point processing in seconds. If incident detection is run alone, set this equal to contents of cols. 13 - 18.
13 - 18	Time period for re-evaluating incident detection, in seconds. Note: Contents of Cols. 13-18 should be an integer multiple (between 1 and 20) of Cols. 7 - 12.
22 - 24	Number of parameters to be input for first incident detection algorithm. Must be $\leq$ 18.
25 - 27	Number of parameters to be input for second incident detection algorithm. Must be $\leq$ 18.
28 - 30	Number of parameters to be input for third incident detection algorithm. Must be $\leq$ 18. Note: Leave Cols. 22-24, 25-27, 28-30 blank if no corresponding algorithm is to be applied.

Cols.	Description
56,57	Assumed average vehicle length for incident detection, point processing and MOE estimation, in feet.
60	(0 or blank, 1) if point processing (is not, is) desired.
63	(0 or blank, 1) if MOE estimation (is not, is) desired. A "1" indicates type 67 card must be present.
79,80	≡65, card type.

Incident Detection Algorithm Parameter Card - Type 66

Up to two type 66 cards may be input for each incident detection algorithm indicated on card type 65. Parameters for each incident detection algorithm must start on a new type 66 card. Table 8 presents examples of the incident detection parameters.

Cols.	Description
1 - 8 9 - 16 ⋮ 65 - 72	Parameters (in floating point) for algorithm specified in Col. 75.
75	Incident detection algorithm to be applied (≤ 3). If two type 66 cards are input for this algorithm, the second need not specify an algorithm number in this column. The second card must, however, follow immediately in the input stream.
79,80	$\equiv$ 66, card type

MOE Algorithm Parameter Card - Type 67

Definitions and examples of MOE algorithm parameters are given in Table 9. Only one card of this type may be present for each IMCES module application.

Note: The same algorithm may be applied up to three times (with different parameters).

Cols.	Description
3	Number of MOE estimation algorithm to be applied, ≤ 3.
4 - 9	Parameter number 1 for algorithm specified in Col. 3, hundredths-of-a-unit. For example, input .08 as 000008 in Cols. 4-9.
10 - 15	Parameter number 2 for algorithm specified in Col. 3, hundredths-of-a-unit.
16 - 21	Parameter number 3 for algorithm specified in Col. 3, hundredths-of-a-unit.
24 - 42	Similar to Cols. 3-21 for another desired MOE estimation algorithm.
45 - 63	Similar to Cols. 3-21 for another desired MOE estimation algorithm.
79,80	$\equiv$67, card type.

Table 9: MOE Algorithm Parameter Definitions and Examples

Parameter Number	ALGORITHM 1 (Ref. 7)	ALGORITHM 2 (Ref. 5)	ALGORITHM 3 (Ref. 6)
1	Rough count error variance (30 veh^2)*	Variance of error term (.08 veh^2)	Initial expected section density error variance (.08 $(veh/lane\text{-}mi)^2$)
2	Variance of trap error term (.08 veh^2)	Ratio of system/observation/noise (between zero and one)	System noise variance (1.1)
3	Initial Kalman filter (between zero and one)	Initial count estimation error variance (veh^2)	Ratio of system/observation noise variance (478)

*Representative values of the parameters are given in parenthesis. The user should input values appropriate to the given problem. See the indicated references for details.

Off-line Incident Detection and/or MOE Estimation Detector Station Card - Type 68

Up to two type 68 cards may be input.

Cols.	Description
1 - 3 4 - 6 . . . 73 - 75	Station numbers to be used for incident detection. Must be input in upstream to downstream order. If there are two or more disconnected freeway sections, the station number sequences representing these sections must be separated by a zero.
77	Code (0,1) if next card (is not, is) a type 68 card.
79,80	≡68, card type.

3.4 Plot Request Input Formats

The following cards should be used if plot output is desired. These cards must occur immediately following a type 99 card with Col. 24 = 1.

Plot Request Cards - Type 70

Cols.	Description
1	Request Code / Meaning: 1 Index of sequential file data request 2 Contour plot request 3 Trajectory plot request 4 Revision of imbedded MOE contour values

If request code 1 was specified (Col. 1), remainder of card should be blank. If request code 4 was specified, a different description prevails for the remainder of this card format. Remaining card formats for codes 2 and 3 follow.

Cols.	Description
2	Last request flag=(0,1) if more INPLOT data (does not, does) follow.
3-5	Run identification number
8-10	Upstream node of roadway section for which plots are to be performed.
13-15	Downstream node of roadway section for which plots are to be performed.
19,20	Lane number (trajectory plots only); = 10 if plots are to be performed for all lanes
25	MOE code (contour only)

Code	MOE
1	Spot speed (mph)
2	Volume (veh/hr/lane)
3	Density (veh/ln-mi)
4	Delay (min/veh)
5	Headway (sec/veh)
6	Travel time (min/veh)
7	All MOEs

Note: See COMMON /CNTR/ description for default values.

Cols.	Description
26-30	Beginning of time period to be plotted (minutes from start of simulation).
31-35	End of time period to be plotted (minutes from start of simulation). Note: For contour plots, the user should specify start and stop times according to what is on the data tape, remembering that contour data is written on the tape at intervals of Δt. There is no data at time=0; the first point is at time=Δt, representing the time interval from 0 to Δt. So, for example, if Δt=1 minute and the user requests a plot from 2 to 4 minutes, the plot will appear with data from .5 to 3.5 minutes. For trajectory plots, the meaning of start and stop times is straightforward.
36-40	Time scale for plotting hundredths-of-a-minute/inch (x-axis for trajectory plots, y-axis for contour plots).
41-45	Distance scale for plotting, feet/inch (x-axis for contour plots, y-axis for trajectory plots). Note: The user should keep in mind the default axis lengths for typical 8 1/2 x 11-inch plots. For contour plots, the x-axis (dist.) is 9 inches; the y-axis (time) is 6 inches. For trajectory plots, the x-axis (time) is 8 inches; the y-axis (dist.) is 6 inches.
46-50	Plot length (must be between 110 and 140 tenths-of-an-inch).
51-55	Plot height (must be between 85 and 110 tenths-of-an-inch). Note: If these fields are zero or blank, a default size of 110, 85 will be used (i.e., 11 x 8 1/2 inches).
79,80	≡70, card type.

If request code 4 (revision of imbedded MOE contour values) was specified in Col. 1, the following format prevails for the remainder of the card.

Cols.	Description
2	MOE identification
6-10 11-15 . . . 71-75	Each of these fourteen fields represents one value of the MOE specified in Col. 2. Contours will be plotted for these values only. Entries should be specified in ascending order. The imbedded values in the program will be replaced, in their entirety, by the values on this card for the remainder of the current application of the INPLOT module or until another Request Code 4 is encountered. Note: Must input desired values x 100 for MOE codes 4, 5 and 6. For MOE codes 1, 2 and 3, input the desired values.
70	≡70, card type.

3.5 Statistical Module Input Formats

The following cards are to be used to activate the Statistical Module. Card Types 90 and 97 must always appear. The term "Statistical Data Tape A" refers to the tape unit referenced by the SIFT simulation as "Statistical Data Tape", FORTRAN logical file 11. "Statistical Data Tape B" is FORTRAN logical file 14.

Statistical Module Control Card - Type 90

This card defines the activity the Statistical Module is to perform. It must always occur immediately after a 99 card with Column 24 = 2.

Cols.	Data Word
1	A code named IC. This code identifies the type of function the Statistical Module is to perform. IC=1 specifies that a statistical analysis comparing two networks is to be performed. IC=2 specifies that a file management operation is to be performed.
3	A code named IM. This code identifies the particular file management function requested. IM=1 Copy contents of Statistical Data Tape A onto Statistical Data Tape B deleting certain files (which must be specified in card type 91). IM=2 Add contents of Statistical Data Tape A to contents of Statistical Data Tape B. IM=3 Produce a listing of the "basic" contents of Statistical Data Tape A. IM=5 Add contents of a file on PUNCH cards. (Card types 95 - 97) to Statistical Data Tape A. IM=6 Add contents of a file on PUNCH cards to empty Statistical Data Tape A.
6	IO= (0,1) if (only freeway links, all links) are to be included in statistical analysis (specify only if IC=1).
13 - 15	File-code number of Network (case) A (specify only if IC=1).

19 - 21	File-code number of Network (case) B (specify only if IC=1).
79, 80	= 90, Card Type

File Update Card - Type 91

This card must be used in conjunction with file management function IM=1 on the Type 90 card. It specifies the code numbers of files to be deleted from the tape in the updating activity. Only one of these cards should be submitted.

Cols.	Data Word
1 - 3	Code number of file to be deleted from tape.
4 - 6	Another file
7 - 9	Another file.
.	.
.	.
.	.
73 - 75	Another file
79, 80	= 91, Card Type.

File Creation Cards

The following cards are to be used to store the results of a field test on the data tape for future comparison against simulation results. They must appear in the card type order and must be positioned between the Type 90 and Type 97 cards.

Network Identification Card - Type 92

Cols.	Data Word
1 - 3	File identification number

Cols.	Data Word	
4 - 6	Number of sub-intervals	
7 - 9	Number of freeway links	
10 - 12	Number of ramp links	Both ramp and surface must be zero if analysis is not desired on non-freeway links
13 - 15	Number of surface links	
79, 80	= 92, Card Type (must be punched).	

Sub-Interval Duration Card - Type 93

Cols.	Data Word
1 - 6	Length of first subinterval (minutes x 100)
7 - 12	Length of second subinterval (minutes x 100)
.	.
.	.
.	.
.	.
.	
73 - 78	Length of thirteenth subinterval (minutes x 100) (if needed).
79, 80	= 93, Card Type (must be punched).

Second card type 93 will contain subinterval 14-26 subinterval length.

Link Identification Card - Type 94

Cols.	Data Word	
1 - 3	Upstream node of link number 1	Order of definition should be freeway, then ramp and then surface links. Start each link type on a new card
4 - 6	Downstream node of link number 1	
7 - 9	Upstream node of link number 2	
10 - 12	Downstream node of link number 2	
.	.	
.	.	
.	.	
.	.	
73 - 75	Upstream node of link number 13	
76 - 78	Downstream node of link number 13	
79, 80	= 94, Card Type (must be punched).	

Include as many card types 94 as necessary. Second card type 94 will contain identity of links 14 through 26 and so on.

Link Data Cards - Type 95 - One of these cards is required for each link for each subinterval. Cards should follow link sequence created by Type 94 cards. All data must be subinterval specific.

Cols.	Data Word
1 - 3	Upstream node number
4 - 6	Downstream node number
8, 9	Sub-interval number (must be in order)
10 - 15	Number of vehicles discharged during the sub-interval
16 - 21	Total travel time in minutes x 100 (732 = 7.3 veh./min.)

Cols.	Data Word
22 - 27	Total delay time in minutes x 100
28 - 33	Total stopped delay in minutes x 100 for ramp and surface links or number of lane changes for freeway links
34 - 39	Total vehicle miles X 100
40 - 45	Average saturation % X 100 for ramp and surface links
46 - 51	Freeway link area (product of link length and number of lanes) in lane-feet. Auxiliary lanes must be included
79,80	= 95, Card Type

The data in columns 10 - 63 are subinterval specific.

Delimiter Card - Type 97

This card signifies the end of Statistical Module information and thus must always be the last card of the input stream. The next 99 card would follow this card.

Cols.	Data Word
1 - 78	Blank
79, 80	= 97, Card Type (must appear)

4.0 INTRAS Model Output

The INTRAS Model produces many standard and optional output formats. The following subsections identify, describe and illustrate each major variety.

4.1 PORGIS and LIS Output

Tables of input parameters are provided, by the PORGIS and LIS modules, for each simulation case run. These tables fully identify the geometric, control and traffic input descriptors which characterize the current study. The values of parameters which may change with time are output each subinterval.

Tables 10, 12, 14, 16, 18, 20 and 22 illustrate the Input Parameter Reports for the traffic network of Figures 1 and 2. Only nodes 9, 10, 11 and 12 have been included in Table 14 for brevity. The format of their sign control output would be similar to that of Node 12. Tables 11, 13, 15, 17, 19, 21 and 23 contain definitions of the column headings on the corresponding Input Parameter Reports.

4.2 Standard SIFT Output

The standard output report formats of the SIFT Module are illustrated in Tables 24, 26 and 28. These reports may be either cumulative or subinterval specific. The latter form is shown. The samples represent the statistical results from one five-minute simulation subinterval for the network of Figures 1 and 2. Table 30 is the intermediate report output showing statistics at two minutes 30 seconds into simulation. Definitions of the column headings for these four output reports are presented in Tables 25, 27, 29 and 31.

The "Freeway Link Station Data" of Table 28 is reported only for locations specified by the user. One such station may be defined for each freeway link.

Table 10: Sample Freeway Link Definition Report

FREEWAY LINKS

L	LINK	LANE	SPAN	AUXILIARY LANES FIRST LGH A D F	AUXILIARY LANES SECOND LGH A D F	MEAN FREE FLOW SPEED	GRADE	PERCENT OF VOLUME/ DESTINATION NODES LEFT	THRU	RIGHT	CURVATURE RAD P EL	RT. LANE OF SEP. PAIR FIRST	SECOND	REC LANE	IDENTIFICATION
1	(701, 1)	3	0	0 0 0 0	0 0 0 0	54	2	0/ 0	100/ 2	0/ 0	0 0 0	0	0	1	FREEWAY-T
2	(1, 2)	3	600	0 0 0 0	0 0 0 0	54	0	0/ 0	100/ 3	0/ 0	1000 1 10	0	0	1	FREEWAY-A
3	(2, 3)	3	198	0 0 0 0	0 0 0 0	54	0	0/ 0	100/ 4	0/ 0	0 0 0	2	0	1	FREEWAY-B
4	(3, 4)	3	249	249 0 0 8	0 0 0 0	54	2	0/ 0	80/ 5	20/ 9	0 0 0	2	0	1	FREEWAY-C
5	(4, 5)	3	600	249 0 8 0	0 0 0 0	54	0	0/ 0	90/ 6	10/ 11	0 0 0	0	0	1	FREEWAY-D
6	(5, 6)	3	198	0 0 0 0	0 0 0 0	54	4	0/ 0	100/708	0/ 0	0 0 0	0	0	1	FREEWAY-E

ADVANCED WARNING SIGNS

L	LINK	DISTANCE FROM DOWNSTREAM NODE	NODE LOCATING OFF-RAMP	DISTANCE FROM OFF-RAMP
2	(1, 2)	450	4	897

Table 11: Definition of Column Headings in "Freeway Link Definition" Report

Column Heading	Definition
L	Freeway link index
LINK	Upstream and downstream nodes of link
LANE	Number of through lanes
SPAN	Link length (feet), no value printed for entry links
AUXILIARY LANES	
LGH	Auxiliary lane length (feet)
A,D,F	The auxiliary lane numeric code (see section 2.1) will appear in the appropriate column to indicate acceleration, deceleration, full auxiliary lane status
MEAN FREE FLOW SPEED	Input value of desired free-flow speed (miles per hour)
GRADE	Imbedded calibration value of grade (percent) which most closely represents the input value
PERCENT OF VOLUME/DESTINATION NODE	Percent of traffic performing the movements left-turn (LEFT), no-turn (THRU) and right-turn (RIGHT) at the downstream intersection; followed by the node number at the downstream end of the next link. Turn percent and destination node number are separated by a slash, "/".
CURVATURE	Indicates set of three parameters used to calculate limiting speed
RAD	Radius of curvature (feet). "0" indicates no value input, implying straight roadway
P	Pavement condition code
EL	Superelevation (percent)
RT. LANE OF SEP. PAIR	Right lane of pair separated by physical barrier. Two such separations are permitted per link, hence, the FIRST and SECOND subheadings
REC LANE	Lane in downstream "through" link receiving traffic from lane 1 of this link
IDENTIFICATION	Text describing link
DISTANCE FROM DOWNSTREAM NODE	Position within link locating advanced warning sign (feet)
NODE LOCATING OFF-RAMP	Node at which off-ramp referenced by advanced warning sign begins
DISTANCE FROM OFF-RAMP	Distance from advanced warning sign to off-ramp (feet)

Table 12: Sample Ramp and Surface Link Definition Report

RAMP LINKS

L	LINK	LANE	SPAN	MEAN FREE FLOW SPEED	GRADE	PERCENT OF VOLUME/ DESTINATION NODES LEFT	THRU	RIGHT	TYPE OF DWNSTREAM INTRSECTN	MEAN QUEUE DISCHGE HEADWAY	LOST TIME	CURVATURE RAD	P	EL	ON/OFF RAMP	REC LANE	IDENTIFICATION
1	(8, 3)	1	300	24	-4	0/ 0	100/ 1	0/ 0	1	0	0	1000	2	5	ON	8	RAMP-G
2	(4, 9)	1	300	24	0	0/ 0	100/ 10	0/ 0	1	24	22	0	0	0	OFF	3	RAMP-I
3	(5, 11)	1	450	24	0	0/ 0	100/]2	0/ 0	1	24	22	0	0	0	OFF	1	RAMP-L

SURFACE LINKS

L	LINK	LANE	SPAN	POCK L	POCK R	MEAN FREE FLOW SPEED	GRADE	PERCENT OF VOLUME/ DESTINATION NODES LEFT	THRU	RIGHT	TYPE OF DWNSTREAM INTRSECTN	LOST TIME	MEAN QUEUE DISCH HEAD	OPP. LINK	LANE CHAN. 1	2	3	4	5	IDENTIFICATION
1	(802, 7)	2	0	0	0	24	2	0/ 0	100/ 8	0/ 0	1	22	24	0	0	0	0	0	0	SURFACE-U
2	(7, 8)	2	350	0	0	24	0	60/ 3	40/ 9	0/ 0	1	22	24	0	0	0	0	0	0	SURFACE-F
3	(8, 9)	2	750	0	0	30	0	0/ 0	100/ 10	0/ 0	1	22	24	0	0	0	0	0	0	SURFACE-H
4	(9, 10)	3	300	0	0	24	0	33/814	34/ 11	33/813	2	15	20	0	4	0	1	0	0	SURFACE-J
5	(10, 11)	1	300	0	0	24	0	0/ 0	100/ 12	0/ 0	1	22	24	0	0	0	0	0	0	SURFACE-K
6	(11, 12)	1	400	0	0	24	0	0/ 0	100/807	0/ 0	1	22	24	0	0	0	0	0	0	SURFACE-M
7	(13, 10)	1	300	0	0	30	0	0/ 0	50/814	50/ 11	2	15	20	0	0	0	0	0	0	SURFACE-O
8	(14, 10)	1	400	0	0	30	0	20/ 11	80/813	0/ 0	2	15	20	7	0	0	0	0	0	SURFACE-P
9	(806, 13)	1	0	0	0	30	0	0/ 0	100/ 10	0/ 0	1	22	24	0	0	0	0	0	0	SURFACE-R
10	(805, 14)	1	0	0	0	30	0	0/ 0	100/ 10	0/ 0	1	22	24	0	0	0	0	0	0	SURFACE-S

Table 13: Definition of Column Headings in "Ramp and Surface Link Identification Report"

Column Heading	Definition
L	Ramp or Surface link index
LINK	Upstream and downstream nodes of link
LANE	Number of lanes (excluding pockets for surface links)
SPAN	Link length (feet), no value printed for entry links
POCK L R	Capacity of Left and Right turn pockets (passenger car vehicle lengths), for surface links only
MEAN FREE FLOW SPEED	Input value of desired free-flow speed (miles per hour)
GRADE	Imbedded calibration value of grade (percent) which most closely represents the input value
PERCENT OF VOLUME/DESTINATION NODE	Percent of traffic performing the movements left-turn (LEFT) no turn (THRU) and right-turn (RIGHT) at the downstream intersection; followed by the node number at the downstream end of the next link. Turn percent and destination node number are separated by a slash, "/".
TYPE OF DWNSTREAM INTRSECTN	Code indicating queue discharge characteristics at downstream intersection
LOST TIME	Time required for first queued vehicle to react to green signal (tenths of a second). A "0" indicates a distribution will be used, referenced by driver type. Not required for on-ramps.
MEAN QUEUE DISCHGE HEADWAY	Mean time between discharge of queued vehicles (tenths of a second)
CURVATURE	Indicates set of three parameters used to calculate limiting speed
RAD	Radius of curvature (feet). "0" indicates no value input, implying straight roadway.
P	Pavement condition code
EL	Superelevation (percent)
ON/OFF RAMP	Indicates, for ramp links, which end connects to freeway
REC LANE	Lane in downstream "through" link receiving traffic from lane 1 of this link
IDENTIFICATION	Text describing link
OPP. LINK	Link index identifying source of traffic opposing left-turners from this link
LANE CHAN	Channelization code indicating restrictive (left-turn only, right-turn only) status of each lane)

Table 14: Sample Sign and Signal Control Definition Report

NODE	INTVL	DURATION	OFFSET	SIGNAL CODES FACING INDICATED APPROACHES (4, 9)	(8, 9)
9	1	56 (47P)	0 (0P)	2	1
9	2	4 (3P)	56 (47P)	2	0
9	3	56 (47P)	60 (50P)	1	2
9	4	4 (3P)	116 (97P)	0	2

NODE	INTVL	DURATION	OFFSET	SIGNAL CODES FACING INDICATED APPROACHES (9, 10)	(13, 10)	(14, 10)
10	1	20 (17P)	5 (4P)	3	3	4
10	2	4 (3P)	25 (21P)	0	0	0
10	3	44 (37P)	29 (24P)	2	9	7
10	4	4 (3P)	73 (61P)	2	0	0
10	5	44 (37P)	77 (64P)	1	2	2
10	6	4 (3P)	1 (1P)	0	2	2

NODE	INTVL	DURATION	OFFSET	SIGNAL CODES FACING INDICATED APPROACHES (5, 11)	(10, 11)
11	1	56 (47P)	60 (50P)	2	7
11	2	4 (3P)	116 (97P)	2	0
11	3	56 (47P)	0 (0P)	1	2
11	4	4 (3P)	56 (47P)	0	2

NODE 12 IS UNDER SIGN CONTROL

NODE	INTVL	DURATION	OFFSET	SIGNAL CODES FACING INDICATED APPROACHES (11, 12)
12	1	0 (100P)	0 (0P)	1

SIGNAL CODE GLOSSARY

CODE	MEANING
0	YIELD SIGN OR AMBER
1	GREEN
2	RED
3	RED WITH GREEN RIGHT ARROW
4	RED WITH GREEN LEFT ARROW
5	STOP OR RED WITH RIGHT TURN PERMITTED
7	NO TURNS - GREEN THRU ARROW
8	RED WITH LEFT AND RIGHT GREEN ARROWS
9	NO LEFT TURN, GREEN THRU AND RIGHT

Table 15

Definition of Column Headings in "Sign and Signal Control Definitions" Report

Column Heading	Definition
NODE	Node number identifying intersection
INTVL	Signal interval number
DURATION	Duration of signal interval (seconds); followed by (in parentheses) percent of signal cycle length represented by this interval. For sign control only one interval is presented of duration "0".
OFFSET	Offset of beginning of interval from reference time (seconds); followed by (in parentheses) percent of signal cycle length represented by this offset.
SIGNAL CODES FACING INDICATED APPROACHES	The upstream and downstream node numbers defining the approach links to the subject intersection are given as column headings. The signal codes defining the permitted movements for each approach during each signal interval are presented under the link identification headings. A glossary of the signal codes is given at the end of this report.

Table 16: Sample Entering Traffic Definition Report

SUB-INTERVAL 1

ENTRY LINK STATISTICS

LINK	TOTAL FLOW RATE (VEH/HR)	PERCENT BY VEHICLE TYPE					PERCENT VEHICLES BY LANE				
		1	2	3	4	5	1	2	3	4	5
(701, 1)	3000	60	20	6	6	8	40	30	30	0	0
(806, 13)	300	70	5	10	15	0	100	0	0	0	0
(802, 7)	600	50	20	10	10	10	50	50	0	0	0
(805, 14)	400	100	0	0	0	0	100	0	0	0	0

VEHICLE TYPE	DESCRIPTION
1	LOW PERFORMANCE PASSENGER CAR
2	HIGH PERFORMANCE PASSENGER CAR
3	INTERCITY BUS
4	HEAVY SINGLE UNIT TRUCK
5	TRAILER TRUCK

Table 17.

Definition of Column Headings in "Entering Traffic Definition" Report

Column Heading	Definition
LINK	Upstream and downstream node numbers which define each entry link
TOTAL FLOW RATE	Rate at which vehicles are generated on the entry link (vehicles/hour)
PERCENT BY VEHICLE TYPE	Percentage of TOTAL FLOW RATE allocated to each vehicle type
PERCENT VEHICLES BY LANE	Percentage of TOTAL FLOW RATE allocated to each lane of link. Applies to freeway entries only.

Table 18: Sample Surveillance System Definition Report

SPECIFICATION OF SURVEILLANCE DETECTORS

DETECTOR STATIONS

LINK(2, 3)

STATION NUMBER	NUMBER	LANE	TYPE	LOCATION	LENGTH
1	1	1	3	150	6
1	2	1	4	140	6
1	3	2	1	150	6
1	4	3	1	150	6

LINK(3, 4)

STATION NUMBER	NUMBER	LANE	TYPE	LOCATION	LENGTH
2	1	1	3	150	6
2	2	1	4	140	6
2	3	2	1	150	6
2	4	3	1	150	6

STATION NUMBER	NUMBER	LANE	TYPE	LOCATION	LENGTH
3	1	1	1	150	6
3	2	2	1	150	6
3	3	3	1	150	6

GLOSSARY

CODE	DETECTOR TYPE
0	DOPPLER RADAR
1	SHORT LOOP
3	DOWNSTREAM LOOP OF COUPLED PAIR
4	UPSTREAM LOOP OF COUPLED PAIR

Table 19

Definition of Column Headings in "Surveillance System Definition" Report

Column Heading	Definition
NUMBER	Sequence number of surveillance detector within link
LANE	Lane containing detector
TYPE	Detector type as defined in "GLOSSARY" at end of report
LOCATION	Distance from upstream node of link to upstream end of detector, or acquisition point for doppler radar (feet)
LENGTH	Detector length (feet), does not apply for doppler radar

Table 20: Sample Incident Definition Report

INCIDENT DATA

LINK	INCIDENT CODE BY LANE 1 2 3 4 5 6 7 8 9 - - - - - - - - -	UPSTREAM LOC. (FT)	LENGTH AFFECTED (FT)	TIME OF ONSET (SEC)	DURATION (SEC)	RUBBERNECK FACTOR (PCT)
(3, 4)	0 1 2 0 0 0 0 0 0	10	20	30	40	50

INCIDENT CODES

0	NOT AFFECTED
1	SLOWED BY RUBBERNECKING
2	BLOCKED

Table 21

Definition of Column Headings in
"Incident Definition" Report

Column Heading	Definition
LINK	Upstream and downstream node numbers which define link
INCIDENT CODE BY LANE	Incident code for each lane of link (as described in glossary at end of report)
UPSTREAM LOC.	Distance from upstream node of link to upstream end of incident (feet)
LENGTH AFFECTED	Length of roadway affected by incident extending downstream from "UPSTREAM LOC." (feet)
TIME OF ONSET	Time that incident begins measured from start of simulation (seconds)
DURATION	Length of time incident exists (seconds)
RUBBERNECK FACTOR	Percentage reduction in capacity due to rubbernecking

Table 22: Sample Run Identification and Control Options Report

CONTROL OPTIONS FOR SUBINTERVAL 1

VARIABLE	VALUE	MEANING
ICTYPE	7	CASE TYPE CODE
IINOT	1	INCIDENT DATA TAPE WILL BE PRODUCED
IPTOT	1	INPLOT DATA TAPE WILL BE PRODUCED
ISTOR	1	CASE DATA TAPE WILL BE PRODUCED
ISTAT	1	STATISTICAL DATA TAPE WILL BE PRODUCED
MINSTS	-0	SIMULATION TIME STEP = 10 TENTHS OF A SECOND FREEWAY TIME STEP MAY EQUAL 20 TENTHS OF A SECOND FOR LIGHT TRAFFIC
RNSEED	7581	RANDOM NUMBER SEED
IDRUN	105	RUN IDENTIFICATION NUMBER
MXINIT	300	MAXIMUM LENGTH OF INITIALIZATION (SEC)
IFILGO	0	FILL TIME ENDS WHEN EQUILIBRIUM IS REACHED
ISTFLG	0	CUMULATIVE STATISTICS
ITPOP	2	TRAJECTORY PLOT DATA OUTPUT INTERVAL (SEC)
NDT	600	LENGTH OF SUBINTERVAL (SEC)
IDMN	300	STATISTICS PRINTOUT INTERVAL (SEC)
NPRNT	300	INTERMEDIATE OUTPUT INTERVAL (SEC)
ISECI	300	TIME OF FIRST INTERMEDIATE OUTPUT FROM START OF SUBINTERVAL (SEC)
IDSEC	300	TIME SPAN FOR INTERMEDIATE OUTPUT (SEC)
HOURS	10 ***	
MINS	0 **	CLOCK TIME AT BEGINNING OF SUBINTERVAL
SECNS	0 ***	
JFUEL	0	FUEL MODULE WILL BE EXECUTED
MFUEL	0	EXOGENOUS FUEL DATA WILL NOT BE READ IN
NU23	0	FUEL DATA WILL BE WRITTEN TO UNIT 23

Table 23: Definition of Column Headings in "Run Identification and Control Option" Report

Column Heading	Definition
VARIABLE	Variable name from COMMON/CONTRL/ or COMMON/S2/ for control option being defined
VALUE	Value for this subinterval
MEANING	Definition of variable corresponding to the value printed

Table 24: Sample Freeway Statistical Report Design

SUBINTERVAL SPECIFIC OUTPUT AT TIME 10 05 00
FREEWAY LINK STATISTICS

		VEHICLES		LANE	CURR	AVG	VEH-	VEH-	SECONDS/VEHICLE				VEH-MIN/ VEH-MILE		VOLUME	DENSITY	SPEED
L	LINK	IN	OUT	CHNG	CONT	CONT	MILES	MIN	TOTAL TIME	MOVE TIME	DELAY TIME	M/T	TOTAL	DELAY	VEH/LN/HR	VEH/LN-MILE	MILE/HR
2	(1, 2)	332	334	25	10	11.4	38.00	57.0	10.2	7.6	2.6	.74	1.50	.38	2000.	50.0	40.0
3	(2, 3)	498	495	16	7	5.9	18.78	29.5	3.5	2.5	1.0	.71	1.57	.70	1990.	52.1	38.2
4	(3, 4)	475	479	19	9	8.0	22.47	40.0	5.0	3.1	1.9	.63	1.78	.67	1907.	56.6	33.7
5	(4, 5)	489	492	20	17	18.7	55.78	93.5	11.4	7.6	3.8	.67	1.67	.56	1965.	54.9	35.8
6	(5, 6)	303	300	23	5	4.5	11.33	22.5	4.5	2.5	2.0	.44	1.99	.88	1809.	59.9	30.2
AVERAGES AND TOTALS				103	48	48.5	146.36	242.5				.66	1.66	.56	1918.	53.8	36.2

NETWORK STATISTICS INCLUDING RAMP AND SURFACE LINKS

VEHICLE-MILES = 200.33, VEHICLE-MINUTES = 428.5, MOVING/TOTAL TRIP TIME = .680,

AVERAGE CONTENT = 85.7, CURRENT CONTENT = 85, SPEED(MPH) = 28.05,

TOTAL DELAY (VEH-MIN) = 137.12, TRAVEL TIME (MIN)/VEH-MILE = 2.14, DELAY TIME (MIN)/VEH-MILE = .68

Table 25: Definition of Column Headings in "Sample Freeway Statistical Report"

Column Headings	Definition
L	Freeway link index
LINK	Upstream and downstream node numbers defining link
VEHICLES IN	Number of vehicles entering link during reporting period
VEHICLES OUT	Number of vehicles leaving link during reporting period
LANE CHNG	Number of lane changes in link during reporting period
CURR CONT	Current number of vehicles on link
AVG CONT	Average number of vehicles on link during reporting period
VEH-MILES	Total distance traveled on link by all vehicles during reporting period (minutes)
VEH-MIN	Total time spent on link by all vehicles during reporting period (minutes)
SECONDS/VEHICLE	
TOTAL TIME	Total time spent on link per vehicle (seconds)
MOVE TIME	Ideal time spent on link per vehicle assuming all vehicles travel at their desired speeds (seconds)
DELAY TIME	Excess time spent on link per vehicle (seconds) DELAY = TOTAL - MOVE
M/T	Ratio of MOVE TIME to TOTAL TIME
VEH-MIN/VEH-MILE	
TOTAL	Time to travel one mile at prevailing speed (minutes)
DELAY	Excess time to travel one mile above that required at desired speed (minutes)
VOLUME	Flow rate of vehicles through link (vehicles/lane/hour)
DENSITY	Concentration of vehicles per unit roadway area (vehicles/lane-mile)
SPEED	Prevailing space mean speed (miles/hour0

Table 26: Sample Ramp and Surface Statistical Report Design

SUBINTERVAL SPECIFIC OUTPUT AT TIME 10 05 00
RAMP AND SURFACE STATISTICS

L	LINK	VEHICLES IN	VEHICLES OUT	CURR CONT	AVG CONT	VEH-MILES	VEH-MIN	SPEED MPH	SECONDS/VEHICLE TOTAL TIME	SECONDS/VEHICLE MOVE TIME	SECONDS/VEHICLE DELAY TIME	M/T	VEH-MIN/VEH-MILE TOTAL	VEH-MIN/VEH-MILE DELAY	PERCENT QUEUE DELAY	AVG SAT PCT	CYCLE FAILURE	LINK TYPE
1	(8, 3)	43	44	2	1.5	2.48	7.5	19.8	10.3	8.6	1.7	.83	3.02	.50	73	10.2	0	Ramp
2	(4, 9)	49	48	2	2.2	2.81	11.0	15.3	13.4	8.6	4.8	.64	3.90	1.40	85	14.9	0	Ramp
3	(5, 11)	48	50	4	3.0	4.20	15.0	16.8	18.2	12.8	5.4	.70	3.57	1.06	79	13.5	0	Ramp
2	(7, 8)	100	102	3	4.6	6.71	23.0	17.5	13.6	9.9	3.7	.73	3.43	.93	91	13.2	1	Surface
3	(8, 9)	97	98	7	8.9	13.87	44.5	18.7	27.3	21.3	6.0	.78	3.21	.71	83	11.8	0	Surface
4	(9, 10)	95	93	4	3.6	5.40	18.0	18.0	11.4	8.6	2.8	.75	3.33	.82	88	12.0	0	Surface
5	(10, 11)	151	149	6	6.8	8.56	34.0	15.1	13.6	8.6	5.0	.63	3.97	1.46	72	15.0	1	Surface
6	(11, 12)	48	47	3	2.2	3.59	11.0	19.6	14.0	11.4	2.6	.81	3.06	.57	79	10.9	0	Surface
7	(13, 10)	47	48	2	2.1	2.71	10.5	15.5	13.2	6.8	6.4	.52	3.87	1.86	89	14.3	0	Surface
8	(14, 10)	46	48	4	2.3	3.64	11.5	19.0	14.4	9.1	5.3	.63	3.16	1.16	90	11.4	0	Surface
AVERAGES AND TOTALS				37	37.2	53.97	186.0	17.4				.71	3.45	1.00	83	12.7	2	

Table 27: Definition of Column Headings in "Sample Ramp and Surface Statistical Report"

Column Headings	Definition
L	Ramp or surface link index
LINK	Upstream and downstream node numbers
VEHICLES IN	Number of vehicles entering link during reporting period
VEHICLES OUT	Number of vehicles leaving link during reporting period
CURR CONT	Current number of vehicles on link
AVG CONT	Average number of vehicles on link during reporting period
VEH-MILES	Total distance traveled on link by all vehicles during reporting period (miles)
VEH-MIN	Total time spent on link by all vehicles during reporting period (minutes)
SPEED	Mean speed of all vehicles on link during reporting period (miles/hour)
SECONDS/VEHICLE	
TOTAL TIME	Total time spent on link per vehicle (seconds)
MOVE TIME	Ideal time spent on link per vehicle assuming all vehicles travel at their desired speeds (seconds)
DELAY TIME	Excess time spent on link per vehicle (seconds) DELAY = TOTAL - MOVE
M/T	Ratio of MOVE TIME to TOTAL TIME
VEH-MIN/VEH-MILE	
TOTAL	Time to travel one mile at prevailing speed (minutes)
DELAY	Excess time to travel one mile above that required at desired speed (minutes)
PERCENT QUEUE DELAY	Percentage of delay time spent in queue
AVG SAT PCT	Average percentage of link area occupied by vehicles during reporting period
CYCLE FAILURE	Number of instances during reporting period when queue present at start of green was not discharged by end of green
LINK TYPE	Identifies link as Ramp or Surface type

Table 28: Sample Freeway Station Headway and Speed Report Design

SUBINTERVAL SPECIFIC FREEWAY LINK STATION DATA
TIME 10 05 00

FREEWAY LINK 2 (1, 2) STATION PLACEMENT 300 FEET FROM NODE 1

LANE	MEAN SPEED MPH	MEAN HEADWAY SEC	PERCENT OF TRAFFIC AT OR BELOW INDICATED SPEED,MPH 26	28	30	32	34	36	38	40	42	44	46	48	50
1	38.9	1.92	1	3	7	15	24	37	51	68	79	86	92	97	99
2	40.5	1.73	0	0	0	4	10	22	36	52	70	85	95	99	100
3	41.0	1.78	0	0	3	8	12	20	30	48	71	87	97	100	100

LANE	PERCENT OF TRAFFIC AT OR BELOW INDICATED HEADWAY,SEC 1.0	1.4	1.8	2.2	2.6	3.0	3.4	3.8	4.2	4.6	5.0	5.4	5.8	6.2
1	10	26	47	63	75	85	89	92	97	100	100	100	100	100
2	20	38	55	69	78	84	88	93	96	99	100	100	100	100
3	18	37	56	70	78	85	89	92	94	97	100	100	100	100

FREEWAY LINK 5 (4, 5) STATION PLACEMENT 250 FEET FROM NODE 4

LANE	MEAN SPEED MPH	MEAN HEADWAY SEC	PERCENT OF TRAFFIC AT OR BELOW INDICATED SPEED,MPH 24	24	26	28	30	32	34	36	38	40	42	44	46
1	34.5	1.99	0	0	0	4	11	27	45	65	81	89	94	99	100
2	36.3	1.77	0	0	1	3	8	15	30	47	65	82	92	97	98
3	36.5	1.76	0	0	0	2	6	14	28	46	63	81	90	96	99

LANE	PERCENT OF TRAFFIC AT OR BELOW INDICATED HEADWAY,SEC. 1.0	1.4	1.8	2.2	2.6	3.0	3.4	3.8	4.2	4.6	5.0	5.4	5.8	6.2
1	16	31	50	65	76	83	89	94	97	99	100	100	100	100
2	18	36	57	71	83	90	95	98	99	100	100	100	100	100
3	20	36	58	70	82	87	93	96	98	99	100	100	100	100

Table 29

Definition of Column Headings in "Sample Freeway Station Headway and Speed Report"

Column Headings	Definition
FREEWAY LINK	Freeway link index followed by upstream and downstream nodes in parentheses
STATION PLACEMENT	Distance from upstream node (feet)
LANE	Lane code number (i.e., 1→5 for through lanes, 6→9 for auxiliary lanes)
MEAN SPEED	Time mean speed for all vehicles crossing station in indicated lane during reporting period (miles/hour)
MEAN HEADWAY	Mean time between passage of individual vehicles for indicated lane during reporting period (seconds)
PERCENT OF TRAFFIC AT OR BELOW INDICATED SPEED	Subheadings beneath this general heading indicate the upper limit of each cell of a cumulative frequency distribution of speed (miles/hour). Under each speed value is displayed the number of vehicles which have passed the station, in the indicated lane, at or below the heading speed value, during the reporting period.
PERCENT OF TRAFFIC AT OR BELOW INDICATED HEADWAY	Subheadings beneath this general heading indicate the upper limit of each cell of a cumulative frequency distribution of headway (seconds). Under each headway value is displayed the number of vehicles which have passed the station, in the indicated lane, at or below the heading headway value, during the reporting period

Table 30: Sample Intermediate Report Output

LINK STATISTICS AT TIME 10 02 30

LINK TYPE	LINK	CON.	VEH DIS	TURN MOVEMENT LEFT	THRU	RT.	CURRENT NUMBER VEH IN LANE 1	2	3	4	5	6	7	8	9	DELAY/ VEH.	QUEUE DLY(P)	CYC FLR	SURFACE LINK CURRENT CHANNELIZATION					AVG SPEED	SIG CODE	LANE CHNG
FRWY	(701, 1)	10	151	0	155	0	5	3	2	0	0	0	0	0	0	0.0	0	0	0	0	0	0	0	0.0	1	0
FRWY	(1, 2)	9	158	0	160	0	2	4	3	0	0	0	0	0	0	2.3	0	0	0	0	0	0	0	40.8	1	15
FRWY	(2, 3)	8	246	0	253	0	4	3	1	0	0	0	0	0	0	1.2	0	0	0	0	0	0	0	38.3	1	5
FRWY	(3, 4)	9	230	0	192	47	2	3	1	0	0	0	0	3	0	2.0	0	0	0	0	0	0	0	33.5	1	9
FRWY	(4, 5)	13	253	0	234	21	5	3	2	0	0	0	0	3	0	3.5	0	0	0	0	0	0	0	35.6	1	9
FRWY	(5, 6)	7	157	0	166	0	4	2	0	0	0	0	0	1	0	2.2	0	0	0	0	0	0	0	31.0	1	11
RAMP	(8, 3)	3	23	0	25	0	3	0	0	0	0	0	0	0	0	1.7	71	0	0	0	0	0	0	19.8	1	0
RAMP	(4, 9)	2	21	0	23	0	2	0	0	0	0	0	0	0	0	4.6	86	0	0	0	0	0	0	15.2	1	0
RAMP	(5, 11)	2	27	0	24	0	2	0	0	0	0	0	0	0	0	5.3	79	0	0	0	0	0	0	16.9	1	0
SURF	(802, 7)	5	58	0	60	0	2	3	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0	0	0.0	1	0
SURF	(7, 8)	2	50	33	21	0	2	0	0	0	0	0	0	0	0	3.7	90	1	0	0	0	0	0	17.6	1	0
SURF	(8, 9)	6	47	0	53	0	2	4	0	0	0	0	0	0	0	6.1	82	0	0	0	0	0	0	18.7	2	0
SURF	(9, 10)	3	45	16	17	15	3	0	0	0	0	0	0	0	0	2.8	85	0	4	0	1	0	0	18.0	1	0
SURF	(10, 11)	5	60	0	64	0	5	0	0	0	0	0	0	0	0	5.1	73	0	0	0	0	0	0	15.3	2	0
SURF	(11, 12)	4	28	0	33	0	4	0	0	0	0	0	0	0	0	2.5	81	0	0	0	0	0	0	19.4	1	0
SURF	(13, 10)	2	23	0	11	11	2	0	0	0	0	0	0	0	0	6.4	87	0	0	0	0	0	0	15.8	2	0
SURF	(14, 10)	5	25	6	24	0	5	0	0	0	0	0	0	0	0	5.2	90	0	0	0	0	0	0	19.9	2	0
SURF	(806, 13)	3	18	0	20	0	3	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0	0	0.0	1	0
SURF	(805, 14)	4	29	0	35	0	4	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0	0	0.0	1	0

Table 31: Definition of Column Headings in "Intermediate Report Output"

Column Headings	Definition
LINK TYPE	Link type indicator
LINK	Upstream and downstream node numbers defining link
CON	Vehicle content on link at time output is called for
VEH DIS	Number of vehicles discharged during reporting period
TURN MOVEMENT LEFT THRU RT	Left-turning, through and right-turning traffic flows at the downstream end of link during reporting period
CURRENT NUMBER OF VEHICLES IN LANE	Vehicle content of lanes
DELAY/VEH	Average delay per vehicle (sec). Not calculated for entry links
QUEUE DLY(P)	Percent of delay time spent in queue. Not calculated for freeway and entry links
CYC FLR	Number of cycle failures on off-ramp and surface links during reporting period
SURFACE LINK CURRENT CHANNELIZATION	Current status of surface link channelization codes
AVG SPEED	Average speed on links during reporting period. Not calculated for entry links
SIG CODE	Signal code facing downstream end of link at time intermediate output is called for. Code is always green for freeway and on-ramp links
LANE CHNG	Number of lane changes occurring during reporting period. Applicable to freeway links only

4.3 FUEL Module Output

Table 32 illustrates the FUEL Module statistics report. Definition of the column headings are provided in Table 33. The sample report in Table 32 displays the fuel consumption and emission statistics for passenger cars and all vehicle types combined. A separate report is produced in a similar format containing commercial vehicle statistics.

4.4 INPLOT Module Output

The INPLOT Module creates CALCOMP digital plots of vehicle time-space trajectories, and contour maps of MOE values in the time-space plane, as requested. Figure 8 is an idealization of the vehicle trajectory plot design. The actual INPLOT output would contain the trajectories of all vehicles traversing the designated roadway section. To assist the user in correlating the plot with the roadway geometry, the position of nodes within the designated roadway section is displayed along the vertical (distance) axis of the plot.

Figure 9 illustrates the contour map output capability of INPLOT. This output form may be produced for several different Measures of Effectiveness including spot speed, volume, density, delay, headway and travel time. Contours are produced which represent constant values of these MOEs. The default family of speed contour values are displayed in Figure 9. A unique symbol is associated with each value and is used to label the plotted contours. The MOE contour values may be updated, as a user option, by card input. It would, for example, be possible for the user to specify a family of speed values of 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61 and 62 mph in order to obtain a much finer contour map than that shown in Figure 9.

As for the trajectory plots, node numbers are displayed along the distance axis for reference.

Table 32: Sample FUEL Consumption and Emissions Report

CUMULATIVE VALUES OF FUEL CONSUMPTION AND OF EMISSIONS

		FUEL CONSUMPTION						VEHICLE EMISSIONS (GRAMS/MILE)								
		GALLONS VEHICLE TYPE			M.P.G. VEHICLE TYPE			HC VEHICLE TYPE			CO VEHICLE TYPE			NO X VEHICLE TYPE		
LINK	TYPE	1	2	6	1	2	6	1	2	6	1	2	6	1	2	6
(1, 2)	FRWY	4.9	5.0	26.1	10.2	8.1	7.5	8.6	7.3	9.1	125.3	131.7	135.3	9.0	9.3	10.4
(2, 3)	FRWY	2.2	2.4	14.7	9.9	7.6	7.0	5.2	5.3	5.9	94.6	104.3	105.7	8.7	8.9	9.8
(3, 4)	FRWY	3.1	3.2	15.6	8.4	6.9	6.6	4.6	4.8	5.1	79.0	85.1	87.2	6.6	6.7	7.9
(4, 5)	FRWY	5.0	5.3	26.0	11.6	8.0	7.8	12.7	13.0	13.3	248.1	252.2	263.9	9.8	10.1	11.3
(5, 6)	FRWY	1.8	2.1	11.1	7.3	6.5	6.4	5.5	6.1	7.6	101.0	102.3	104.6	8.8	9.7	11.0
(8, 3)	RAMP	2.9	3.1	15.8	6.6	5.0	4.8	3.6	3.9	4.2	56.5	59.7	61.5	8.0	8.8	9.9
(4, 9)	RAMP	3.0	3.4	16.2	5.0	3.9	4.0	2.7	3.3	3.3	39.5	40.4	41.0	5.9	6.7	7.2
(5, 11)	RAMP	3.8	4.1	21.0	5.8	4.0	3.9	3.0	3.5	3.7	44.9	52.8	55.1	6.0	7.1	8.1
(7, 8)	SURF	2.7	2.9	15.0	4.2	3.9	3.9	4.2	4.9	5.0	63.9	64.3	65.4	6.6	6.9	7.9
(8, 9)	SURF	5.4	5.4	26.0	6.0	4.2	4.1	5.6	6.0	6.2	100.8	102.0	103.3	7.3	7.3	7.9
(9, 10)	SURF	2.6	2.7	14.9	4.3	3.6	3.4	3.3	3.4	4.9	45.2	57.3	60.8	5.1	5.2	6.3
(10, 11)	SURF	2.5	2.6	14.8	5.8	4.1	4.0	2.9	3.4	4.0	38.7	38.9	39.2	5.9	6.4	7.0
(11, 12)	SURF	2.9	3.1	15.8	5.3	4.0	3.9	3.8	4.1	5.0	55.5	58.6	60.5	8.3	8.9	9.2
(13, 10)	SURF	2.7	2.7	14.2	5.8	3.9	4.0	3.0	3.5	4.7	58.1	59.4	59.7	7.2	7.6	8.8
(14, 10)	SURF	3.0	3.3	16.0	4.9	3.6	3.4	2.7	2.9	3.8	41.3	43.2	47.0	6.1	6.2	7.4
NETWORK-WIDE STATISTICS																
		48.5	51.3	263.2	5.3	4.9	4.0	4.6	5.0	5.4	84.3	89.7	91.0	7.2	7.6	8.7

VEHICLE TYPE 1 = LOW PERFORMANCE PASSENGER CAR

2 = HIGH PERFORMANCE PASSENGER CAR

6 = ALL VEHICLE TYPES

Table 33: Definition of Column Headings in "Fuel Consumption and Emissions Report"

Column Heading	Definition
LINK	Upstream and downstream nodes of link.
TYPE	Text indicating link type.
FUEL CONSUMPTION GALLONS	Number of gallons consumed by specified vehicle types on link.
M.P.G.	Mileage averaged by vehicles of specified type on link.
VEHICLE EMISSIONS (GRAMS/MILE)	
HC	Hydrocarbon emissions on link for specified vehicle types.
CO	Carbon monoxide emissions on link for specified vehicle types.
NOX	Oxides of nitrogen emissions on link for specified vehicle types.
NETWORK-WIDE STATISTICS	Totals for fuel consumption and emissions for specified vehicle types. Figures for GALLONS represent sums. All others are means.
VEHICLE TYPE	Definition of vehicle types described in table.

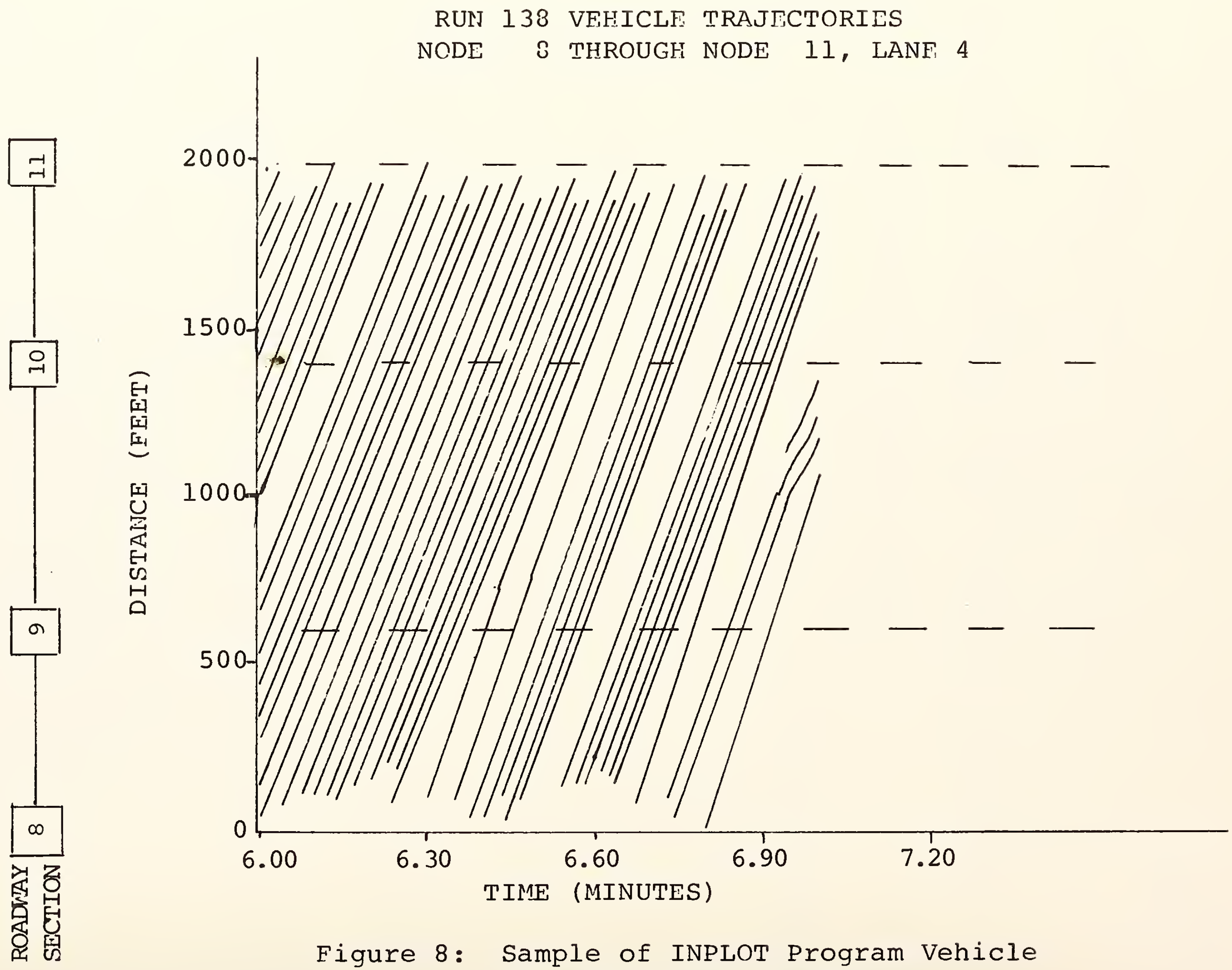


Figure 8: Sample of INPLOT Program Vehicle Trajectory Plot Design

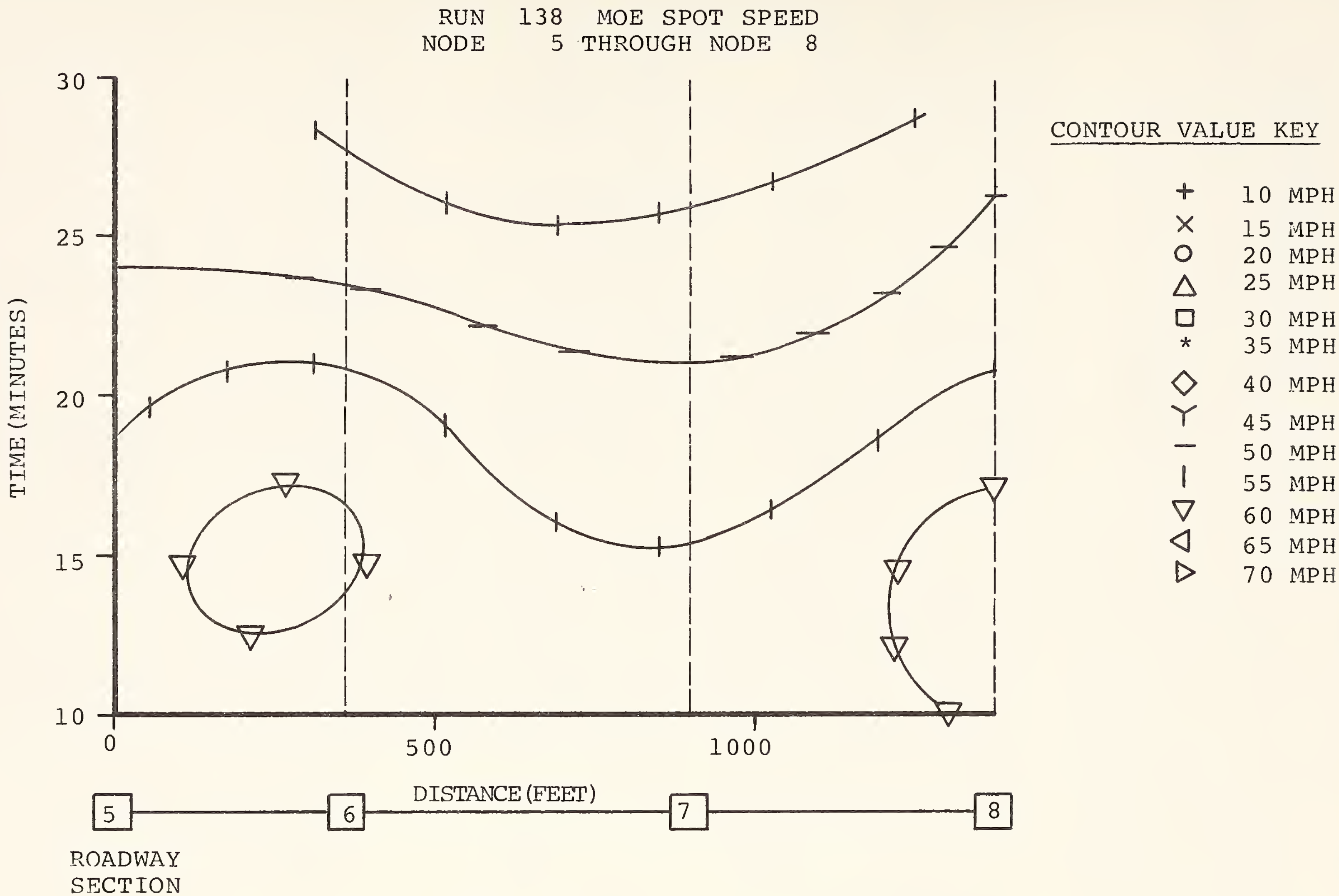


Figure 9: Sample of INPLOT Program Contour Plot Design

4.5 INCES Module Output

The result of processing surveillance detector output is reported by the INCES module in three formats, illustrated in Tables 34, 35 and 36. Table 34 illustrates the output of the point processing procedures which calculate traffic parameter values on a detector specific basis. The Simulation Run number ("999" in the illustrative example) corresponds to the Run Identification number on the Type 00 card.

To illustrate the MOE estimation and incident detection output formats, it is assumed that a series of fully detectorized (one detector in each lane) stations have been defined by the user along the length of the freeway. Table 35 is an example of the MOE estimation report, produced by INCES, for a consecutive pair of such stations. The "VOLUME IN" and "VOLUME OUT" values are mean values across all lanes at the upstream and downstream stations, respectively. "SPACE MEAN SPEED" and "DENSITY" are estimates generated by the particular MOE estimation procedure employed.

Table 36 is a sample of the incident detection output report. As for the MOE report, one table is generated for each algorithm. In the sample, a compression wave was sensed during the sixth evaluation period and confirmed by the tenth period. Subsequently, the incident terminated and traffic was assumed to be freely moving by the fourteenth evaluation period.

4.6 SAM Module Output Reports

Reports will be generated by the SAM module containing simple comparisons and statistical tests of MOE values from separate simulation runs. The MOEs to be studied are:

Table 34: Sample Point Processing Report Design

INCES POINT PROCESSING OUTPUT

SIMULATION RUN 999

FREEWAY LINK 3 (2, 3), DOPPLER RADAR DETECTOR IN LANE 3 AT 50 FEET FROM NODE 2

	EVALUATION PERIOD											
	120	240	360	480	600	720	840	960	1080	1200	1320	1440
VOLUME,VPH	1900	1862	1857	1883	1990	1942	1910	1894	1771	1792	1824	1836
TIME MEAN SPEED,MPH	39.5	39.8	40.0	39.9	38.5	38.3	39.4	39.6	40.4	40.1	39.7	39.7
MEAN HEADWAY,SEC	1.89	1.93	1.94	1.91	1.81	1.85	1.88	1.90	2.03	2.01	1.97	1.96

FREEWAY LINK 3 (2, 3), COUPLED LOOP DETECTOR IN LANE 3 AT 90 FEET FROM NODE 2

	EVALUATION PERIOD											
	120	240	360	480	600	720	840	960	1080	1200	1320	1440
VOLUME,VPH	1895	1865	1856	1885	1989	1946	1905	1895	1773	1791	1827	1837
TOTAL MEAN SPEED,MPH	39.5	39.9	40.2	39.8	38.5	38.6	39.2	39.3	40.5	40.1	40.0	39.6
MEAN HEADWAY,SEC	1.90	1.93	1.94	1.91	1.81	1.85	1.89	1.90	2.03	2.01	1.97	1.96
MEAN OCCUPANCY	.182	.177	.175	.179	.196	.191	.194	.183	.166	.169	.173	.176

Table 35: Sample MOE Estimation Report Design

INCES MOE ESTIMATION OUTPUT, SIMULATION RUN 999
ALGORITHM 2

FROM
STATION 1, LINK 2
TO
STATION 2, LINK 3

TIME (SEC)	VOLUME IN VPHPL	VOLUME OUT VPHPL	SPACE MEAN SPEED MPH	DENSITY VEHICLES PER LANE MILE	VOLUME IN VPHPL	VOLUME OUT VPHPL	SPACE MEAN SPEED MPH	DENSITY VEHICLES PER LANE MILE	VOLUME IN VPHPL	VOLUME OUT VPHPL	SPACE MEAN SPEED MPH	DENSITY VEHICLES PER LANE MILE
20	1880	1885	38.5	48.9								
40	1861	1858	39.0	47.7								
60	1865	1866	39.1	47.7								
80	1878	1873	38.8	48.3								
100	1892	1895	37.6	50.4								
120	1921	1850	33.5	56.2								
140	1893	1801	31.0	59.6								
160	1890	1787	28.6	64.2								
180	1898	1799	27.3	67.6								
200	1905	1800	26.4	70.1								
220	1840	1813	25.7	71.1								
240	1833	1852	26.1	70.6								
260	1851	1908	28.3	66.5								
280	1866	1890	29.3	64.2								
300	1869	1885	30.0	62.5								

Table 36: Sample Incident Detection Report Design

INCES INCIDENT DETECTION OUTPUT, SIMULATION RUN 999

ALGORITHM 3

PARAMETER 1 = 6.000000+E01, PARAMETER 2 = 2.000000+E01, PARAMETER 3 = 3.000000+E00, PARAMETER 4 = 1.000000+E01

PARAMETER 5=-4.400000-E01, PARAMETER 6 = 3.100000-E01, PARAMETER 7 = 2.900000+E01, PARAMETER 8 = 3.000000+E01

	FROM STATION 1, LINK 2 TO STATION 2, LINK 3					
TIME (SEC)	STATE	STATE	STATE	STATE	STATE	STATE
20	FREE					
40	FREE					
60	FREE					
80	FREE					
100	FREE					
120	CWAV					
140	CWAV					
160	CWAV					
180	TENT					
200	CONF					
220	INCD					
240	INCD					
260	TERM					
280	FREE					
300	FREE					

CODE	DEFINITION
FREE	NO INCIDENT IN SECTION
TERM	INCIDENT TERMINATED
CWAV	COMPRESSION WAVE
TENT	TENTATIVE INCIDENT
CONF	INCIDENT CONFIRMED
INCD	INCIDENT IN PROGRESS

MOE	Application
Vehicles Discharged	All Links and Network
Delay Time (veh-min)	All Links and Network
Lane Changes	Freeway Links
Density	Freeway Links and Network
Avg. Saturation Percent	Non-Freeway Links
Vehicle-Miles	All Links and Network
Travel Time (veh-min)	All Links and Network
Volume	Freeway Links
Time in Queue (veh-min)	Non-Freeway Links
Average Speed	All Links and Network

Tables 37 through 41 illustrate the various SAM report formats comparing two statistical data sets for a simple three-link network simulated for three 5-minute time periods (subintervals). The simple data comparisons of Table 34 are repeated for all appropriate MOEs of the Freeway and Non-Freeway link categories. The same is true for the statistical test results of Tables 39 and 40. The term NETWORK may indicate all links, or, optionally, all freeway links.

The terms "CASE A" and "CASE B" identify the particular network statistical data sets as specified on the SAM input card type 90.

Table 37: Sample SAM Data Element Paired Comparisons

NUMBER OF VEHICLES DISCHARGED
CASE A,CODE NO. 100
CASE B,CODE NO. 714

FREEWAY LINKS

SUBINTERVAL

LINK		TOTAL	1	2	3	4	5	6	7	8	9	10	11	12
(1, 2)	MOE(A)	851	299	272	280									
	MOE(B)	827	291	265	271									
	(A)-(B)	24	8	7	9									
	(A)/(B)	1.03	1.03	1.03	1.03									
(2, 3)	MOE(A)	809	295	253	261									
	MOE(B)	815	288	265	262									
	(A)-(B)	-6	7	-12	-1									
	(A)/(B)	.99	1.02	.95	1.00									
(3, 4)	MOE(A)	906	310	302	294									
	MOE(B)	926	307	315	304									
	(A)-(B)	-20	3	-13	-10									
	(A)/(B)	.98	1.01	.96	.97									

Table 38: Sample SAM Network Comparisons

NETWORK WIDE MOE - FREEWAY LINKS ONLY
CASE A, CODE NO. 100
CASE B, CODE NO. 714

SUBINTERVAL

		TOTAL	1	2	3	4	5	6	7	8	9	10	11	12
NUMBER VEHICLES DISCHARGED	MOE(A)	855	301	276	278									
	MOE(B)	856	295	282	279									
	(A)-(B)	-1	6	-6	-1									
	(A)/(B)	1.00	1.02	.98	1.00									
TOTAL DELAY TIME-MIN.	MOE(A)	13	5	4	5									
	MOE(B)	12	4	4	4									
	(A)-(B)	1	1	0	2									
	(A)/(B)	1.08	1.08	1.00	1.17									
VEHICLE MILES	MOE(A)	57	20	18	19									
	MOE(B)	56	20	18	18									
	(A)-(B)	1	0	0	1									
	(A)/(B)	1.01	1.00	1.00	1.02									
VEHICLE MINUTES	MOE(A)	75	26	24	25									
	MOE(B)	74	26	24	24									
	(A)-(B)	1	0	0	1									
	(A)/(B)	1.01	1.00	1.00	1.04									
DENSITY VEH/LN-MILE	MOE(A)	25.1	26.4	24.1	24.9									
	MOE(B)	24.9	25.7	24.6	24.4									
	(A)-(B)	.2	.7	-.5	.5									
	(A)/(B)	1.01	1.03	.98	1.02									
AVERAGE SPEED	MOE(A)	45.4	45.6	45.8	44.8									
	MOE(B)	45.9	46.0	45.8	45.8									
	(A)-(B)	-.5	-.4	.0	-1.0									
	(A)/(B)	.99	.99	1.00	.98									

Table 39: Sample SAM Link Specific Statistical Test Report

NUMBER OF VEHICLES DISCHARGED
ANALYSIS OF LINK STATISTICS

FREEWAY LINKS

	CASE A		CASE B		T-TEST	WILCOXON	U-TEST	ONE-WAY ANOVA		
	MEAN	VARIANCE	MEAN	VARIANCE	T	T/Z	U/Z	SSW	SSB	F
(1, 2)	283.7	192.34	275.7	185.34	.71	-1.60	-.65	755.3	96.0	.51
(2, 3)	269.7	497.34	271.7	202.34	.13	-.53	-.65	1399.3	6.0	.02
(3, 4)	302.0	64.00	308.7	32.34	1.18	-1.07	-1.09	192.7	66.7	1.38

Table 40: Sample SAM Subinterval Specific Statistical Test Report

NUMBER OF VEHICLES DISCHARGED
ANALYSIS OF SUBINTERVAL STATISTICS

FREEWAY LINKS

SUBINTERVAL	CASE A		CASE B		T-TEST	WILCOXON	U-TEST	ONE-WAY ANOVA		
	MEAN	VARIANCE	MEAN	VARIANCE	T	T/Z	U/Z	SSW	SSB	F
1	303.3	66.14	295.3	107.33	1.06	- .53	- .65	340.9	96.0	1.13
2	275.7	610.33	281.7	833.33	.27	.00	-1.09	2887.3	54.0	.07
3	278.3	274.33	279.0	489.00	.04	-1.07	-1.09	1526.7	.7	.00

Table 41: Sample SAM Network Statistical Test Report

ANALYSIS OF NETWORK WIDE STATISTICS
FREEWAY LINKS ONLY

MOE	CASE A		CASE B		T-TEST	WILCOXIN	U-TEST	ONE-WAY ANOVA		
	MEAN	VARIANCE	MEAN	VARIANCE	T	T/Z	U/Z	SSW	SSB	F
NUMBER VEHICLES	285.1	385.61	285.3	414.25	.02	1.36	- .04	6398.9	.2	.00
TOTAL DELAY TIME-MIN.	4.4	4.28	4.1	5.11	.29	-1.02	- .62	75.1	.4	.09
VEHICLE MILES	19.1	103.76	18.8	92.95	.06	- .91	- .04	1573.7	.4	.00
VEHICLE MINUTES	25.1	173.11	24.6	164.78	.08	-1.59	- .18	2703.1	1.1	.01
DENSITY VEH/LN-MILE	25.13	3.02	24.9	2.36	.30	- .91	-1.41	43.0	.2	.09
AVERAGE SPEED MPH	45.70	1.86	45.86	1.71	.73	- .91	-1.41	28.6	.9	.53

4.7 INTRAS Warning and Error Message Output

Experience with computer programs containing complex data verification procedures has shown that the reporting of error conditions often proves costly in terms of computer storage due to the storage consumed by FORMAT statements. A generalized error message procedure was designed for INTRAS to alleviate the storage demands of diagnostic processing.

Each recognizable error condition in INTRAS generates a standard message which identifies the message code number and reports the current value of up to 10 pertinent parameters. To determine the error condition, the user should refer to Appendix B. It will identify the condition and parameter meanings corresponding to the particular message code.

Because the INTRAS program contains nine major overlay modules, each with its own family of reportable error conditions, the message code numbers are stratified by originating module as follows:

Module	Message Codes
INTRAS	1- 99
PORGIS	100-399
LIS	400-499
POSPRO	500-549
FUEL	550-599
SIFT	600-699
INCES	700-799
INPLOT	800-899
SAM	900-999

The following is an example of the INTRAS generalized error message format:

```
****  ERROR 108, PARAMETERS =        63,           2,          50
```

The error message code, 108, indicates that the message originates from PORGIS. The explanation corresponding to message code 108 is as follows:

108 Node P_1, specified on Type P_2 card, is larger than maximum allowable node number P_3.

When applying this to the example, we find that a node 63, specified on a type 2 card, is larger than the maximum allowable node number which is 50.

Table 42 lists all the error message codes and the routines they originate from.

Table 42: Origin of Message Codes

Module	Routine	Error Message Codes
INTRAS	INTRAS	1, 2, 4-9
	FINDL	107
PORGIS	PORGIS	100-105, 107, 108, 155, 388-392, 394-399
	LPAK	106
	PRSIG	161-180, 191, 193
	PRACT	268, 269
	CTPFF	270, 271, 273-279
	CTPSX	280-293
	CTPSV	294-299
	PRMSND	181-188, 190, 192
	SURVIN	101, 108, 200-208
	INCIN	250-256, 260, 262
	IMBED	250, 251, 257-259
	DETGEN	261
	LINKIN	100, 103, 105, 109-123, 125-132, 139, 149, 151, 153, 154
	CHKNOD	130, 131, 138
	TURNIN	100, 103, 148, 156, 157
	INT1	122, 124, 133-137, 140, 143-147, 150, 152
LIS	LIS	394, 399, 400, 401

Table 42: Origin of Message Codes (Concluded)

Module	Routine	Error Message Codes
SIFT	VPAK	617
	FINDFV	613
	FINDRV	614
	FINDSV	615
	CAL1	631-634
	CAL2	631-639
	CAL3	631-634, 636-642
	CAL4	631-634, 636-639, 643, 644
	CAL5	631, 645-647
HICON	SELEN	611
	SEVEN	612
	SVEH	616
	CLOSE	600
	BLOK	606, 607
	TSTSAT	604
	HDWY	605
	LANES	608
	MOOV	602, 609
	FGNRAT	660
	OFFRMP	680, 681
	CLNUP	651
	INCDAT	700
	DETECT	305
	FMAIN	660
FUEL	FUEL	550-552
SAM	SAM	900-906
INPLOT	INPLOT	800-803, 812
	CONTR	807
	PAGE	810, 811
	PATH	808, 809
	TRAJEC	806
INCES	INCES	701-716

5. DECK STRUCTURE AND OPERATING PROCEDURES

As with any unfamiliar computer program, the major tasks confronting the potential user are: how to communicate input parameters and options to the program, and, how to make the local computer system accept and execute the program. The preceding sections have described the input formats, program and file structures for the INTRAS model. At this point, a user who had a good deal of computer programming and/or applications experience could probably develop control cards (operating system control commands) which would allow him to execute INTRAS. This presumes, of course, that the user also has the INTRAS program deck at his disposal.

The user who is lacking in computer experience needs to follow an established procedure in order to effectively utilize a computer program. To aid the neophyte computer user and to expedite the application of INTRAS by those with computer exposure, the following subsections are provided illustrating the deck and control configuration for typical program run types.

5.1 Creation and Revision of a Program Object Module

The first task facing the user (hopefully with the assistance of someone knowledgeable in the workings of the local computer system) is to create an executable machine language version of INTRAS. This translation of the FORTRAN source code is highly machine and system dependent. Although it is not the purpose of this document to give a "short course" on the workings of the target IBM and CDC operating systems, examples of the procedure are given in this section as prototypes. The specific devices available at, and standards of the individual computer installation, will probably dictate changes in these prototypes.

Figures 10 and 11 illustrate the control card deck setup for a typical IBM installation operating under IBM/OS. Figure 10 illustrates a preparatory run performed to reserve (allocate) space on a magnetic disc device for storage of the object (load) module.

Figure 11 contains the prototype Job Control Language (JCL) necessary to translate the FORTRAN program and create

```
// EXEC PGM=IEFBR14
//CREATE DD DSN=INTRAS.LOADMOD,VOL=SER=...,UNIT=.....,
// DCB=(RECFM=U,BLKSIZE=6400,SPACE=(TRK,(100,100,5)),
// DISP=(,KEEP)
//
```

Figure 10: Allocation of 360/370 Disc Space

```
//EXEC FORTGCL,PARM.LKED='OVLY'
//FORT,SYSIN DD *
*********PLACE ROUTINES TO BE RECOMPILED HERE
/*
//LKED.SYSLMOD DD DSN=INTRAS.LOADMOD,VOL=SER=......,UNIT=...,DISP=SHR
//LKED.SYSIN DD *
INCLUDE SYSLMOD(INTRAS)
INSERT MAIN,EROT,DBUG,DRWS,INTVAR,ULNKR,ULNKS,UVR,UVS,UNPAK,PAK,PLNKR
INSERT PLNKS,PVR,PVS,FINDLN,FINDL,NEXTLN,LRANK
INSERT SIZE,A1,A2,A3,A4,A5,A6,A7,A8,A9,A10,A11,A12,S1,S2,S3,CONTRL,ERTRAN
INSERT P1,FORINC,FPAR,ONVEH,RANK,FREDAT,NFILTS,CFUEL,CRASH,DBLEXP,IHEAD
INSERT IPLTN,LASDCH,ACT0,ACT1,ACT2,ACT3,ACT4,ACT7,ACT8,ACT9,ACT10,ACT12
INSERT ACT20
OVERLAY ALPHA
INSERT PORGIS,TABCON,LPAK,PRSIG,PRACT,CTPFF,CTPSX,CTPSV,CLRALL,PRMSND
INSERT SURVIN,INCIN,SIGOUT,INACT,FLOOUT,SUROUT,INCOUT,IMBED,IMBEDO,DETGEN
INSERT MATCH,LINKIN,CHKNOD,LINOUT,TURNIN,INT1
INSERT IMBDIN,ACT11,ACT16
OVERLAY ALPHA
INSERT LIS,LLPAK,LPRSIG,LCLRAL,LPRACT,LCTPFF,LCTPSX,LCTPSV,LPRMSN,LSURVI
INSERT LINCIN,LSIGOU,LFLOOU,LINACT,LSUROU,LINCOU,LIMBED,LIMBDO,LDETGE
INSERT LLINKI,LLINOU,LTURNI,LINT1
INSERT IMBDIN,ACT11,ACT16
OVERLAY ALPHA
INSERT SIFT,VPAK,LASTLK,FRSTV,LASTV,FINDFV,FINDRV,FINDSV,RANDOM
INSERT NIDTSV,VPOINT,VBUF,NRGY,INCDMP
OVERLAY BETA
INSERT HICON,UPSIG,SIGACT,PDAFZ,PDNAFZ,UPACT,GRNSIG,REDSIG,TERMFZ,DECACT
INSERT TERM,ACTFZ,ASIG,DETSW,FZCL,CAL1,CAL2,CAL3,CAL4,CAL5,CAL6,CAL8,CAL9
INSERT MOOV,SVEH,CLOSE,BLOK,GOQ,OFFRMP,HDWY,GETCD,LSWCH,LANES,TSTSAT,DETECT
INSERT TSIG,NORM,CLNUP,INCDAT,TPTOUT,MOEV,QSTATE,SELEN,FILL,RELEN
INSERT SEVEN,GETUNV,REVEN,FMAIN,FMOVE,FGNRAT,ONRMP,CHOOZ,FRESET
INSERT CONSOL,EMGNCY,CHANGE,CHECK,RISK,LCROSS,ALANE,CANCEL
INSERT ADVANC,COLECT,TYPE
INSERT LENVI,SRFLAG,VENVI,VEER,ACT5,ACT6,ACT11,ACT15,ACT16,ACT18
OVERLAY BETA
INSERT LOCON,INIT,RESET,FILTST,FTSC,CPTOUT,CYCP,INTST
OVERLAY ALPHA
INSERT FUEL,BDFLCN,BDHCEM,BDCOEM,BDNOEM
INSERT BFUEL
OVERLAY ALPHA
INSERT INCES,READET,POINT,POUT,INC1,INC2,INC3,PINC,MOE1,MOE2,MOE3,MOUT
INSERT TTIME
INSERT INCDMP,PDATA,INCEST,AMD,MTOC,TRVTM,NUMP
OVERLAY ALPHA
INSERT POSPRO
OVERLAY ALPHA
INSERT INPLOT,AXPLOT,COMPCT,CONTR,CPLOT,FILEX,IOPROC,LEGEND,PAGE,PATH
INSERT SEARCH,SPTAL,TPLOT,TRAJEC
INSERT IPERR,CRD,TMDAT,T1,PLT,CNTR,CHT,LANET
OVERLAY ALPHA
INSERT SAM,READCL,PRINT,STAT,TTEST,CALC,ANOVA,WILCOX,UTEST,RANK
INSERT SAMP2,SAMP3
ENTRY MAIN
NAME INTRAS(R)
/*
//                                        exclude this card for
//                                        first compile
```

Figure 11: 360/370 Basic Compilation and Revision of INTRAS Simulation Model

an executable load module configured in the INTRAS overlay structure. Since disc space has been allocated by the preliminary run, the procedures to compile (translate) and link edit are the same, whether the entire program is compiled or only individual routines are revised and replaced. For the first compilation, the "INCLUDE SYSLMOD (INTRAS)" card should be omitted.

The preparation and revision of an object module for the CDC Version of INTRAS is illustrated by Figures 12 and 13. It is not necessary to run a preliminary disk space allocation run, however, the form of the creation and revision runs are somewhat different. Figure 12 illustrates the object creation deck setup. Note that generation of the proper overlay structure is contingent on the correct ordering of the input program deck (as indicated in the figure).

To revise the CDC version object module, it is necessary to execute the deck illustrated in Figure 13. This computer run will edit the newly compiled subroutines into the previous full object module. The edited object module will be stored as a permanent disc file as was its predecessor.

5.2 INTRAS Data Deck Structure

The order of card inputs in the INTRAS data deck must meet certain criteria for successful program execution. The data deck may be thought of as a series of blocks, each containing certain card types. Some of these blocks are optional depending on the particular application. Figure 14 illustrates the complete block structure and the card types (some of which may be optional) which may be present in each block.

Block 1 - This initial block contains the Run Control Card for each case. Essentially, it identifies which other data blocks follow. This block must be present in the input data deck for all applications of INTRAS. If applications are batched (i.e., two separate simulations are performed or the INPLOT or SAM module is to be exercised), then this Block must occur as the first block for each application.

```
INTRAS, T100.
ACCOUNT(.....,.....)
REQUEST(OBJECT,*PF)
FTN(I=INPUT,A,B=OBJECT, EL=I,P,R=0)
CATALOG(OBJECT,INTRASOBJECT,ID=....,RP=999)
****(Column 1 of this card should contain 7, 8 and 9
    punches)
    Place deck for INTRAS Main Program here.  First card
    must be "OVERLAY(INTRS1,0,0)"
    Next come the source decks for SUBROUTINES EROT, DBUG,
    DRWS, INTVAR, ULNKR, ULNKS, UVR, UVS, UNPAK, PAK,
    PLNKR, PLNKS, PVR, PVS, FINDLN, FINDL, NEXTLN, LRANK.
    Place decks for PORGIS Main Program here.  First card
    must be "OVERLAY(INTRS2,1,0)"
    Next come the source decks for SUBROUTINES TABCON,
    LPAK, PRSIG, PRACT, CTPFF, CTPSX, CTPSV, CLRALL,
    PRMSND, SURVIN, INCIN, SIGOUT, INACT, FLOOUT, SUROUT,
    INCOUT, IMBED, IMBEDO, DETGEN, MATCH, LINKIN, CHKNOD,
    LINOUT, TURNIN, INT1.
    Place decks for LIS Main Program here.  First card
    must be "OVERLAY(INTRS3,2,0)"
    Next come the source decks for SUBROUTINES LLPAK,
    LPRSIG, LPRACT, LCTPFF, LCTPSX, LCTPSV, LCLRAL,
    LPRMSN, LSURVI, LINCIN, LSIGOU, LINACT, LFLOOU,
    LSUROU, LINCOU, LIMBED, LIMBDO, LDETGE, LLINKI,
    LLINOU, LTURNI, LINT1.
    Place decks for SIFT Main Program here.  First card
    must be "OVERLAY(INTRS4,3,0)"
    Next come the source decks for SUBROUTINES VPAK,
    LASTLK, FRSTV, LASTV, FINDFV, FINDRV, FINDSV, RANDOM.
    Place decks for HICON Main Program here.  First card
    must be "OVERLAY(HIACTY,3,2)"
    Next come the source decks for SUBROUTINES UPSIG,
    SIGACT, PDAFZ, PDNAFZ, UPACT, GRNSIG, REDSIG, TERMFZ,
    DECACT, TERM, ACTFZ, ASIG, DETSW, FZCL, CAL1, CAL2,
    CAL3, CAL4, CAL5, CAL6, CAL8, CAL9, MOOV, SVEH, CLOSE,
    BLOK, GOQ, OFFRMP, HDWY, GETCD, LSWCH, LANES, TSTSAT,
    DETECT, TSIG, NORM, CLNUP, INCDAT, TPTOUT, MOEV,
    QSTATE, SELEN, FILL, RELEN, SEVEN, GETUNV, REVEN,
    FMAIN, FMOVE, FGNRAT, ONRMP, CHOOZ, FRESET, CONSOL,
    EMGNCY, CHANGE, CHECK, RISK, LCROSS, ALANE, CANCEL,
    ADVANC, COLECT, TYPE.
```

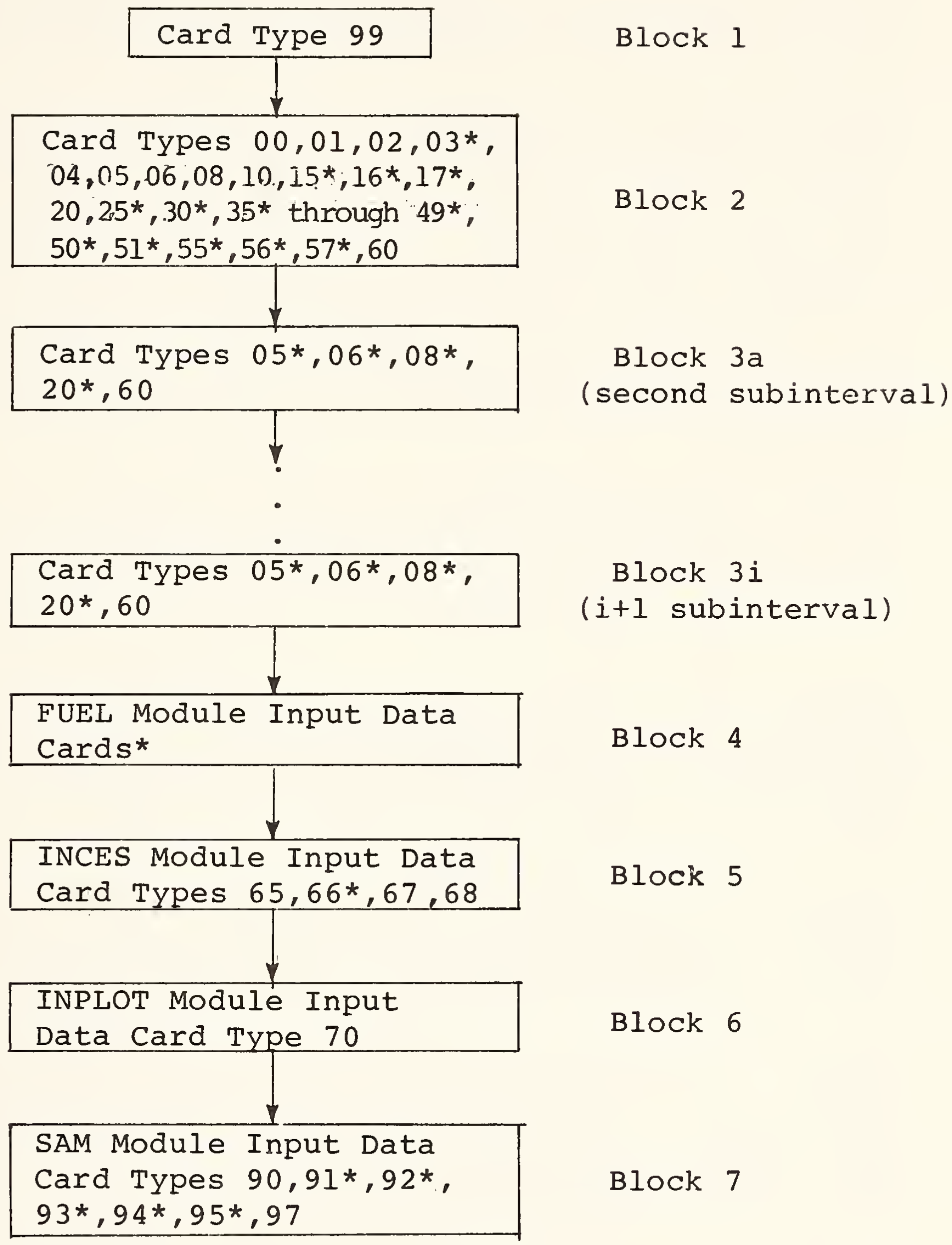
Figure 12: Generation of Full CDC Version INTRAS Object Module

Place decks for LOCON Main Program here. First card must be "OVERLAY(LOACTY,3,1)"
Next come the source decks for SUBROUTINES INIT, RESET, FILTST, FTSC, CPTOUT, CYCP, INTST.
Place decks for FUEL Main Program here. First card must be "OVERLAY(INTRS5,4,0)"
Next come the source decks for SUBROUTINES BDFLCN, BDHCEM, BDCOEM, BDNOEM.
Place decks for INCES Main Program here. First card must be "OVERLAY(INTRS6,5,0)"
Next come the source decks for SUBROUTINES READET, POINT, POUT, INC1, INC2, INC3, PINC, MOE1, MOE2, MOE3, TTIME, MOUT.
Place deck for POSPRO Main Program here. First card must be "OVERLAY(INTRS7,6,0)"
Place deck for INPLOT Main Program here. First card must be "OVERLAY(INTRS10,7,0)"
Next come the source decks for SUBROUTINES AXPLOT, COMPCT, CONTR, CPLOT, FILEX, IOPROC, LEGEND, PAGE, PATH, SEARCH, SPTAL, TPLOT, TRAJEC.
Place deck for SAM Main Program here. First card must be "OVERLAY(INTRS11,10,0)"
Next come the source decks for SUBROUTINES READCL, PRINT, STAT, TTEST, CALC, ANOVA, WILCOX, UTEST, RANK.
**** (Column 1 of this card should contain 6, 7, 8 and 9 punches)

Figure 12: Generation of Full CDC Version INTRAS Object Module (concluded)

```
INTRAS,T100.
ACCOUNT (....,.....)
REQUEST(NEWOB,*PF)
ATTACH(OLDOB,INTRASOBJECT,ID=.....)
FTN(I=INPUT,A,B=OBJECT,EL=I,P,R=0)
REWIND(OBJECT)
COPYL(OLDOB,OBJECT,NEWOB)
REWIND(NEWOB)
CATALOG(NEWOB,INTRASOBJECT,ID=.....,RP=999)
****(Column 1 of this card should contain 7, 8 and 9
    punches
    Place decks to be compiled here.  If Main programs of
    any overlay modules are compiled, then the "OVERLAY"
    card must be included as the first card of each such
    Main program.
****(Column 1 of this card should contain 6, 7, 8 and 9
    punches)
```

Figure 13: Revision of CDC Version INTRAS Object Module



*Denotes optional card type

Figure 14: INTRAS Data Deck Block Structure

Block 2 - This block contains all of the required and optional data needed to execute a one subinterval (or first subinterval of a multiple subinterval) simulation run.

Block 3a, 3b...3i - This block type is repeated for the second, and all subsequent, subintervals of a multiple subinterval simulation run. The data cards included in Block 3 allow link parameters to be varied from subinterval to subinterval. If a card is omitted from this block, the parameter values normally specified on that card will retain the values from the previous subinterval. Generally, if a card is included for a particular link, then all data fields on the card pertaining to that link should be specified.

Block 4 - This block type contains revisions to the built-in fuel consumption and vehicle emissions tables of the FUEL Module. FUEL may be exercised with or without Block 4. In the latter case, the built-in values are used.

Block 5 - This block contains input parameter data required to execute the point processing, MOE estimation and incident detection algorithms of the INCES module. If INCES is not required (on-line incident detection does not require the INCES module) then Block 5 may be omitted.

Block 6 - This block contains parameters which specify digital plotting activities to be performed by the INPLOT module. INPLOT is always executed alone so that the data deck for an INPLOT run consists of only Blocks 1 and 6.

Block 7 - This block contains parameters specifying the statistical activities to be performed by the SAM module. SAM is always executed alone so that the data deck for a SAM run consists of only Blocks 1 and 7.

Figure 15 illustrates the block structures for three different hypothetical data decks. The module which reads each block is indicated adjacent to the block in the figure. The following discussion describes the function and possible purpose of the runs represented by these data decks.

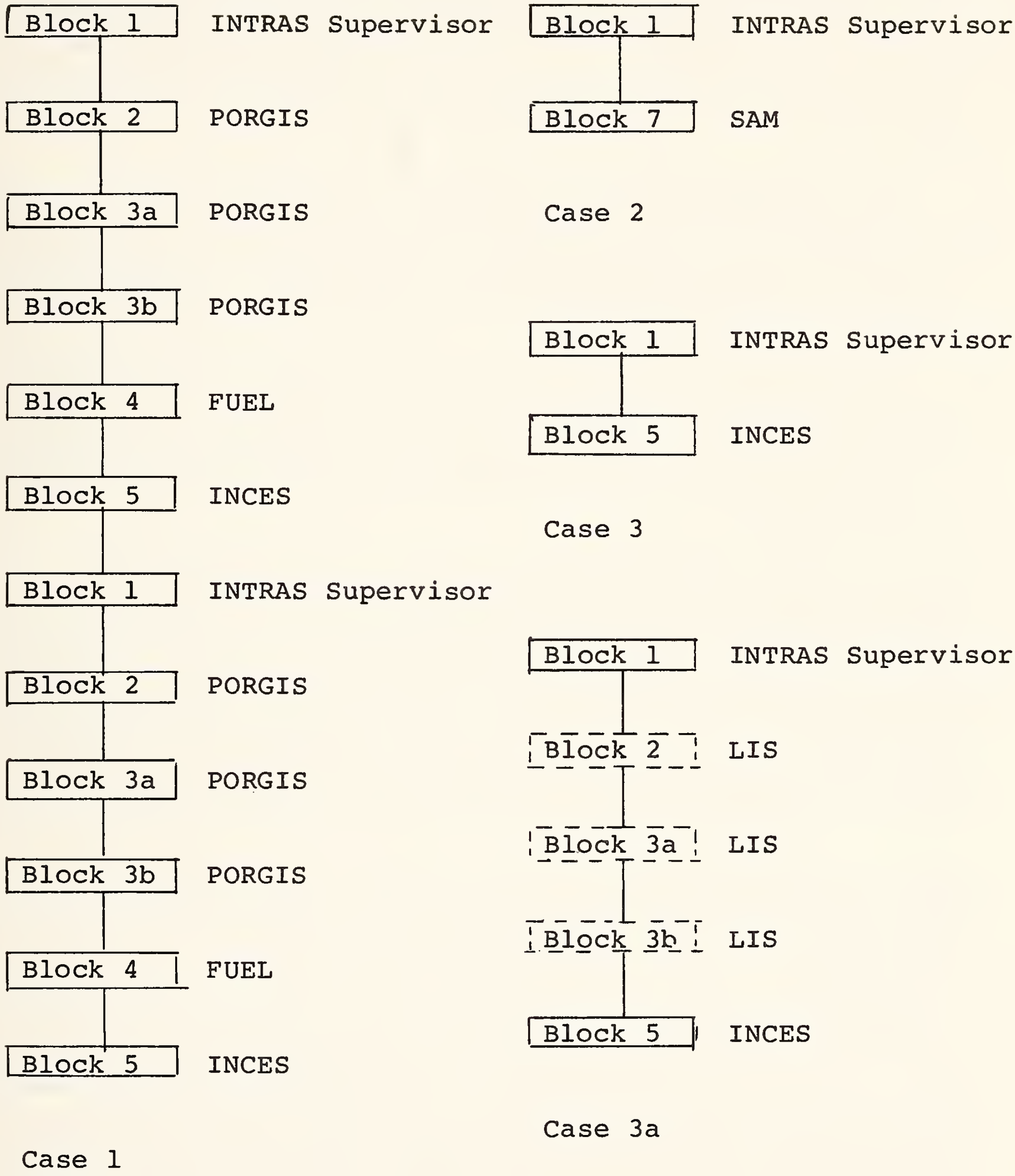


Figure 15: Hypothetical INTRAS Data Deck Structures

Case 1 - The deck structure of Case 1 would be used to execute two successive simulation cases. Each of the simulations would be followed by execution of the FUEL and INCES modules. As mentioned earlier, FUEL could be exercised without Block 4. The inclusion of Block 4 in the Case 1 data deck indicates that a revision is to be made in the built-in data tables.

The execution of INCES indicates that these simulations do not employ on-line incident detection control algorithms, but rather, that detector point processing, MOE estimation and/or incident detection evaluations are to be performed following each simulation.

During the execution of the simulations, the Case 1 user might well be creating and storing statistical and/or plotting data for future use. Whether or not this occurs is dependent upon specifications in the Type 99 Run Control Card of Block 1.

Case 2 - The deck structure of Case 2 illustrates the required sequence of blocks to perform a statistical analysis (via the SAM module) of data stored previously on the Statistical Data Tape. Case 2 might well be a follow-up to Case 1 if the Case 1 user had chosen to output statistics for the two simulations. Case 2 would then compare the two statistical output sets and determine if significant differences were present in these results.

Case 3 - The deck structure of Case 3 could represent two different applications. First, Case 3 might simply be the application of INCES to data stored, during the execution of a simulation study, on the INCES Data Tape.

Second, a current simulation may be performed during Case 3 followed by the application of INCES. This could occur if the simulation data had been submitted as an early run to PORGIS and then stored if it were free of errors on the Case Data Tape. This procedure would allow the user to "shake-down" simulation data cases at high priority during the day, and then run the more costly simulation at low priority overnight.

Case 3a illustrates the implied order of blocks read by INTRAS for this type of application. Blocks enclosed by dotted lines are not in the physical deck submitted by the

user. Rather, they are extracted from the Case Data Tape and read by the LIS module. All parameters required to specify this procedure are included in the Type 99 Run Control Card of Block 1.

5.3 Execution of the INTRAS Program

In Section 5.1 examples of the preparation of program load modules for IBM 360/370 and CDC 6600/7600 applications were presented. In this section, the execution of those modules under the IBM/OS and CDC/SCOPE operating systems will be described. As with the earlier examples, local (installation specific) characteristics may require slight modifications in the procedures presented here. The following examples are intended as prototypes from which analogs may be drawn to suit the hardware or software peculiarities of the individual computer system.

Figure 16 illustrates the IBM/OS JCL (Job Control Language) needed to execute the (IBM Version) object program load module created in the example of Section 5.1. Depending on the particular application, the data definitions for certain files (DD's) may be replaced by dummies. The FORTRAN logical file number consists of the third and fourth characters of the file name field FT12F001 ("12" in this case) of the DD statement. Table 43 identifies the files which may be replaced by dummies, the necessary conditions for replacement and the replacement DD statement.

Six of the files used by INTRAS may be retained by the user. These files (numbers 8, 9, 11, 12, 19 and 23) are assumed to reside on tape in the prototype of Figure 16. Since tape intensive computer runs are often impractical, it is recommended that the user consult with local systems personnel to determine the procedures needed to place the desired files in permanent disc storage.

Figure 17 illustrates the CDC/SCOPE control statements needed to execute the (CDC Version) object program load module created in the example of Section 5.1. As for the IBM version certain files may not be needed for particular applications. No action need be taken by the user to omit utility files 14, 15, 16, 17, 20, 21, 22, 24 and 25. Table 44 indicates those cards to be removed from the deck of Figure 17 if any permanent optional files are to be omitted.

```
// EXEC PGM=INTRAS
//STEPLIB DD DSN=INTRAS.LOADMOD,VOL=SER=.....,UNIT=.....,DISP=SHR
//FT06F001 DD SYSOUT=A,DCB=(RECFM=FA,LRECL=133,BLKSIZE=133)
//FT07F001 DD SYSOUT=B,DCB=(RECFM=F,LRECL=80,BLKSIZE=800),
// SPACE=(CYL,(1,1))
//FT08F001 DD LABEL=(1,NL),VOL=(PRIVATE,RETAIN,SER=.....)
// UNIT=(2400-1,,DEFER),DISP=(,KEEP),DCB=(RECFM=F,LRECL=80,BLKSIZE=800,DEN=2)
//FT09F001 DD LABEL=(1,NL),VOL=PRIVATE,RETAIN,SER=.....),
// UNIT=(2400-1,,DEFER),DISP=(,KEEP),DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804,DEN=2)
//FT11F001 DD LABEL=(1,NL),VOL=(PRIVATE,RETAIN,SER=.....),
// UNIT=(2400-1,,DEFER),DISP=(,KEEP),DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804,DEN=2)
//FT12F001 DD LABEL=(1,NL),VOL=(PRIVATE,RETAIN,SER=.....),
// UNIT=(2400-1,,DEFER),DISP=(,KEEP),DCB=(RECFM=F,LRECL=2044,BLKSIZE=2048,DEN=2)
//FT13F001 DD UNIT=SYSDA,DCB=(RECFM=F,LRECL=80,BLKSIZE=800),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT14F001 DD UNIT=SYSDA,DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT15F001 DD UNIT=SYSDA,DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT16F001 DD UNIT=SYSDA,DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT17F001 DD UNIT=SYSDA,DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT19F001 DD LABEL=(1,NL),VOL=(PRIVATE,RETAIN,SER=.....),
// UNIT=(2400,,DEFER),DISP=(,KEEP),DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804)
//FT20F001 DD UNIT=SYSDA,DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT21F001 DD UNIT=SYSDA,DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT22F001 DD UNIT=SYSDA,DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT23F001 DD LABEL=(1,NL),VOL=(PRIVATE,RETAIN,SER=.....),
// UNIT=(2400,,DEFER),DISP=(,KEEP),DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804)
//FT24F001 DD UNIT=SYSDA,DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT25F001 DD UNIT=SYSDA,DCB=(RECFM=VBS,LRECL=80,BLKSIZE=804),
// SPACE=(CYL,(5,5)),DISP=(,DELETE)
//FT05F001 DD *
**** Place Data Cards Here ****
/*
//
```

Figure 16: IBM 360/370 Execution of INTRAS

Table 43: Allowable Dummy Data Definitions for IBM 360/370 Execution of INTRAS

FORTRAN Logical File No.	Necessary Conditions for Replacement	Dummy Data Definition (DD)
8	No Case Data Tape required	//FT08F001 DD UNIT=SYSDA,SPACE=(CYL,(1,1)), // DCB=(RECFM=F,LRECL=80,BLKSIZE=800)
9	No simulation performed or no detectors in simulation	//FT09F001 DD DUMMY
11	No retention of simulation statistics for SAM and no SAM run performed	//FT11F001 DD DUMMY
12	No INPLOT run performed	//FT12F001 DD DUMMY
14	No SAM run performed	//FT14F001 DD DUMMY
15	Same as for File 11	//FT15F001 DD DUMMY
16	Same as for File 9	//FT16F001 DD DUMMY
17	Same as for File 11	//FT17F001 DD DUMMY
19	No retention of simulation data for INPLOT and no INPLOT RUN performed	//FT19F001 DD DUMMY
20	Same as for File 12	//FT20F001 DD DUMMY
21	Same as for File 12	//FT21F001 DD DUMMY
22	No FUEL run performed (with or without simulation)	//FT22F001 DD DUMMY
23	Same as for File 22	//FT23F001 DD DUMMY
24	Same as for File 22	//FT24F001 DD DUMMY
25	Same as for File 22	//FT25F001 DD DUMMY

```
INTRAS,T200.
ACCOUNT(....,......)
ATTACH(OBJECT,INTRASOBJECT,ID=.....)
REQUEST(CASED,MT,HY,RING,VSN=......)
REQUEST(INCESD,MT,HY,RING,VSN=......)
REQUEST(SAMD,MT,HY,RING,VSN=......)
REQUEST(PLOT,MT,LO,RING,VSN=......)
REQUEST(INPLOTD,MT,HY,RING,VSN=......)
REQUEST(FUELD,MT,HY,RING,VSN=......)
OBJECT(,,,CASED,INCESD,SAMD,PLOT,INPLOTD,FUELD)
UNLOAD(CASED)
UNLOAD(INCESD)
UNLOAD(SAMD)
UNLOAD(PLOT)
UNLOAD(INPLOTD)
UNLOAD(FUELD)
**** (Column 1 of this card should contain 7, 8 and 9
     punches)
**** Place Data Cards Here ****
**** (Column 1 of this card should contain 6, 7, 8 and 9
     punches)
```

Figure 17: CDC 6600/7600 Execution of INTRAS

Table 44: CDC/SCOPE Control Cards To Be Omitted for Dummy Files

FORTRAN Logical File No.	Control Cards To Be Omitted If File Is Not Required
8	REQUEST(CASED,MT,HY,RING,VSN=......) UNLOAD(CASED)
9	REQUEST(INCESD,MT,HY,RING,VSN=......) UNLOAD(INCESD)
11	REQUEST(SAMD,MT,HY,RING,VSN=......) UNLOAD(SAMD)
12	REQUEST(PLOT,MT,LO,RING,VSN=......) UNLOAD(PLOT)
19	REQUEST(INPLOTD,MT,HY,RING,VSN=......) UNLOAD(INPLOTD)
23	REQUEST(FUELD,MT,HY,RING,VSN=......) UNLOAD(FUELD)

The conditions for omitting a file are those previously specified in Table 43 for the IBM version.

6. CASE STUDY

To ease the task of assimilating the foregoing text, an input preparation case study has been devised. This case study is based upon the traffic network illustrated earlier in Figures 1 and 2. The output report examples of Section 4 are, for the most part, products of this case study. Figure 18 illustrates a data deck coded for INTRAS. Most of the features of the INTRAS simulation model would be exercised by this data. Its primary purpose is to illustrate the preparation of input data. The following briefly describes the contents and purpose of the various data cards.

Card 1: Run Control Card Type 99

The data on this card specifies that:

- This case will involve diagnostic testing, simulation and incident detection
- The Incident Data, INPLOT Data, Case Data, Statistical Data and FUEL Data Tapes will be produced
- At least one more case follows
- The FUEL Module will be exercised

Card 2: Title Card

The data on this card specifies:

- Title of run
- The default time step will be used
- This is Run "105"
- The default Random Number Seed is to be used

```
                                                                                  Card #
07        11 11                                                                  99      1
INTRAS DEMONSTRATION CASE                                          105           00      2
DUMMY NETWORK                                                         300 11   11 00000 01      3
701  1      3553         2              1  2 10003552         3    10  4         02      4
  2  3  5003553 00       4              3  4 10003553         5  9 10  5         02      5
  4  5  6003553          6 11           5  6  6003552       708                  02      6
802  7     1352          8              7  8  3501352     3  9                   02      7
  8  3  3002351          4              8  9 12001352 00     10                  02      8
  4  9  3002351         10              9 10  5001353   814 11813                02      9
 10 11  3001351   C     12              5 11  4502351        12                  02     10
 11 12  4001352        807                                                       02     11
 13 10  3001301        814 11            14 10  4001301  0 11813                 02     12
                                        806 13     1301      10                  02     13
805 14     1301         10                                                       02     14
701  1          FREEWAY-T  1  2         FREEWAY-A  2  3        FREEWAY-B         03     15
  3  4          FREEWAY-C  4  5         FREEWAY-D  5  6        FREEWAY-E         03     16
802  7          SURFACE-U  7  8         SURFACE-F  8  3           RAMP-G         03     17
  8  9          SURFACE-H  4  9            RAMP-I  9 10        SURFACE-J         03     18
 10 11          SURFACE-K  5 11            RAMP-L 11 12        SURFACE-M         03     19
                          13 10         SURFACE-0 14 10        SURFACE-P         03     20
                         806 13         SURFACE-R805 14        SURFACE-S         03     21
701  1                     1             1  2                    1             5004     22
  2  3                     1 20          3  4      3             1 20         25004     23
  4  5     2  250          I             5  6                    1               04     24
  8 31     8                             4  9124   3                             05     25
  5 11124  2                                                                     05     26
802  7124 22                             7  8124 22                              06     27
  8  9124 22                             9 10124 22           4 1                06     28
 10 11124 22                            11 12124 22                              06     29
                                        13 10124 22                              06     30
 14 10124 22 13                                                                  06     31
806 13124 22                            805 14124 22                             06     32
701  1   100     1  2   100    2  3   100     3  4    80 20  4  5    90 10       08     33
  5  6   100   802  7   100    7  8 40 60     8  3   100     8  9   100          08     34
  4  9   100     9 10 33 34 33 10 11  100     5 11   100    11 12   100          08     35
805 14   100    13 10    50 50 14 10 10 90   806 13   100                        08     36
  1      701               1                                                     10     37
  2        1               1                                                     10     38
  3        2  8           10                                                     10     39
  4        3               1                                                     10     40
  5        4               1                                                     10     41
  6        5               1                                                     10     42
  7      802               1                                                     10     43
  8        7               1                                                     10     44
  9     0  4  8           01                                                     10     45
 10     0  9 13 14        324  10  020   4  211  24  200   4  122  44  022      410     46
 11        5 10           01                                                     10     47
 12       11               1                                                     10     48
 13      806               1                                                     10     49
 14      805               1                                                     10     50
701  1  4000 20  6  6  8 3030          806 13   300 20 10 15  0                  20     51
802  7   600 20 10 10 10               805 14   300 20  0  0  0                  20     52
  2  3  1503 61 10  1501 62     1501 63                       1     1            25     53
  3  4  1503 61 10  1501 62     1501 63                      63     2            25     54
  4  5  1501 61     1501 62     1501 63                             3            25     55
  3  4012000000   10 20    300   300 50                                          30     56
                                                             10                  49     57
  2     1  2  3  4  5  6                                                         50     58
   600300300300300     1                                                         60     59
701  1  5000 20  6  6  8 3030                                                    20     60
   600300300300300     1                                                         60     61
701  1  3400 20  6  6  8 3030                                                    20     62
   600300300300300     0                                                         60     63
 16  0    60    60     3                                    17  1  0             65     64
 8.0     50.0     8.0                                                     1      66     65
  1  2  3                                                                        68     66
10                     1                                                         99     67
30105    1    6             4   15   10  500  140  110                           70     68
```

Figure 18: Case Study Input Data

Card 3: Network Name

The data on this card specifies:

- Network descriptive name
- Initialization is to be a maximum of 300 seconds in duration
- Simulation will not begin unless equilibrium is attained
- Clock time at the start of simulation is 10:00:00

Cards 4 through 14: Link Geometry

The data on these cards define the roadway sections (links) of the network and their interconnection with other links. For each link, the following characteristics, which will prevail throughout the simulation, are specified.

- Length
- Gradient
- Link Type (Surface, Ramp, Freeway)
- Mean Free-flow Speed
- Location of Early Warning Signs for Freeway Links

Cards 15 through 21: Link Names

These optional cards contain 24 character alphanumeric descriptions for selected links.

Cards 22 through 24: Freeway Link Operations

The data on these cards define physical characteristics of the freeway links which will prevail throughout the simulation. Specifically these characteristics are:

- Curvature
- Auxiliary Lane Geometries

- Lane Separation Barriers
- Superelevation
- Pavement Condition
- Lateral Alignment with Succeeding Link
- Station Location for Reporting Freeway Statistics

Cards 25 and 26: Ramp Link Operations

The data on these cards define physical characteristics of the ramp links, which will prevail throughout the simulation, as well as behavioral characteristics which may change for each new subinterval. Specifically, these characteristics are:

- Intersection "Type" (queue discharge distribution indicator)
- Mean Queue Discharge Headway
- Lateral Alignment with Succeeding Link
- Curvature, Superelevation and Pavement Condition

Cards 27 through 32: Surface Link Operation

The data on these cards define physical characteristics of the surface links, which will prevail throughout the simulation, as well as behavioral characteristics which may change for each new subinterval. Specifically, these characteristics are:

- Intersection "Type" (queue discharge distribution indicator)
- Mean Queue Discharge Headway
- Lost Time for First Vehicle in Queue
- Identification of Link Opposing Left Turners
- Geometrics of Left and Right Turning Pockets

- Lane Specific Channelization

Cards 33 through 36: Link Turning Movements

The data on these cards specify, for all links, the proportion of vehicles which turn left, go straight through, or turn right when discharging from the specified link.

Cards 37 through 50: Sign and Signal Control

The data on these cards specify the control exercised on vehicles approaching all nodes of the network. Specifically, the control characteristics are:

- Duration of each signal interval for signal controlled nodes

- Control Code facing each approach (by interval for signal control)

- Offset of Interval 1 for signal controlled nodes

Cards 51 and 52: Volume

The data on these cards specify the incoming volume characteristics for each entry link in the traffic network. Specifically, these volume characteristics are:

- Flow rate

- Percentage of each vehicle type

- For freeway entries, percentage of volume assigned to each lane

Cards 53 through 55: Surveillance System

The data on these cards define the geometrics of surveillance detectors in the traffic network. Specifically, these geometrics are:

- Type of detector
- Position of detector
- Size of detector (for induction loops)
- Detector station numbers

Card 56: Incident Specification

The data on this card defines an incident occurring in the traffic network. The incident characteristics are:

- Location of incident
- Roadway area affected (lanes and length)
- Nature of incident (blockage or rubbernecking)
- Onset and duration of incident

Card 57: Revision to Commercial Vehicle Freeway Lane Preference

The presence of this card indicates that a revision is to be made in the imbedded values of the percent of commercial vehicles assigned to each freeway lane. The contents of this card specify the revised commercial vehicle percentages.

Card 58: Output of Trajectories for Plotting

The presence of this card indicates that freeway vehicle trajectory data will be recorded on the INPLOT Data Tape. The contents of this card indicate the particular freeway links for which trajectories will be output.

Card 59, 61 and 63: Simulation Control

The data on these cards define subinterval specific parameters required for this three-subinterval simulation run. Specifically, these parameters are:

- Duration of subinterval
- Time and frequency of output reports
- Flag indicating whether there are more subintervals

Cards 60 and 62: Revised Subinterval Volumes

The presence of these cards indicate that incoming volumes (or other volume related parameters) will be revised, during the second and third simulation subintervals, for the specified entry link. Note that numerous other card formats could have been included for subinterval specific parameter revisions (see Block 3a of Figure 14).

Card 64: Off-line INCES Detector Processing

The presence of this card is mandated by the specification (in Card 1, the Type 99 card) that INCES will be exercised. The data on this card specify options and parameters needed for off-line detector processing. These options and parameters are:

- Flag indicating that detector specific (Point Processing) evaluations are to be performed
- Flag indicating that MOE estimation evaluations are not to be performed
- Flag indicating that loop detector data is to be treated as digital
- Polling frequency for digital mode
- Assumed vehicle length
- Specification of reevaluation time periods for incident detection
- Number of parameters required for the incident detection algorithm

Card 65: Incident Detection Algorithm Parameters

The data on this card specifies the parameters to be used for the given incident detection algorithm. The algorithm number is also specified.

Card 66: Detector Station Specification

The data on this card indicate those detectorized freeway locations which are to be used for incident detection.

Card 67: Run Control for Second Case

The data on this card indicate:

- An INPLOT run is to be performed
- No more data cases follow

Card 68: Trajectory Plot Request

The data on this card indicates:

- Trajectory plots are to be performed for all lanes of traffic network using data stored on the INCES data tape
- The length of freeway for which trajectories are to be plotted is specified
- The time period for which trajectories are to be plotted is specified
- The time and space plotter scaling is specified

The foregoing data deck example is by no means exhaustive of the variations which a user may choose to submit to INTRAS. It is hoped that sufficient analogies exist to ease the task of submitting data for execution of the INTRAS program.

APPENDIX A

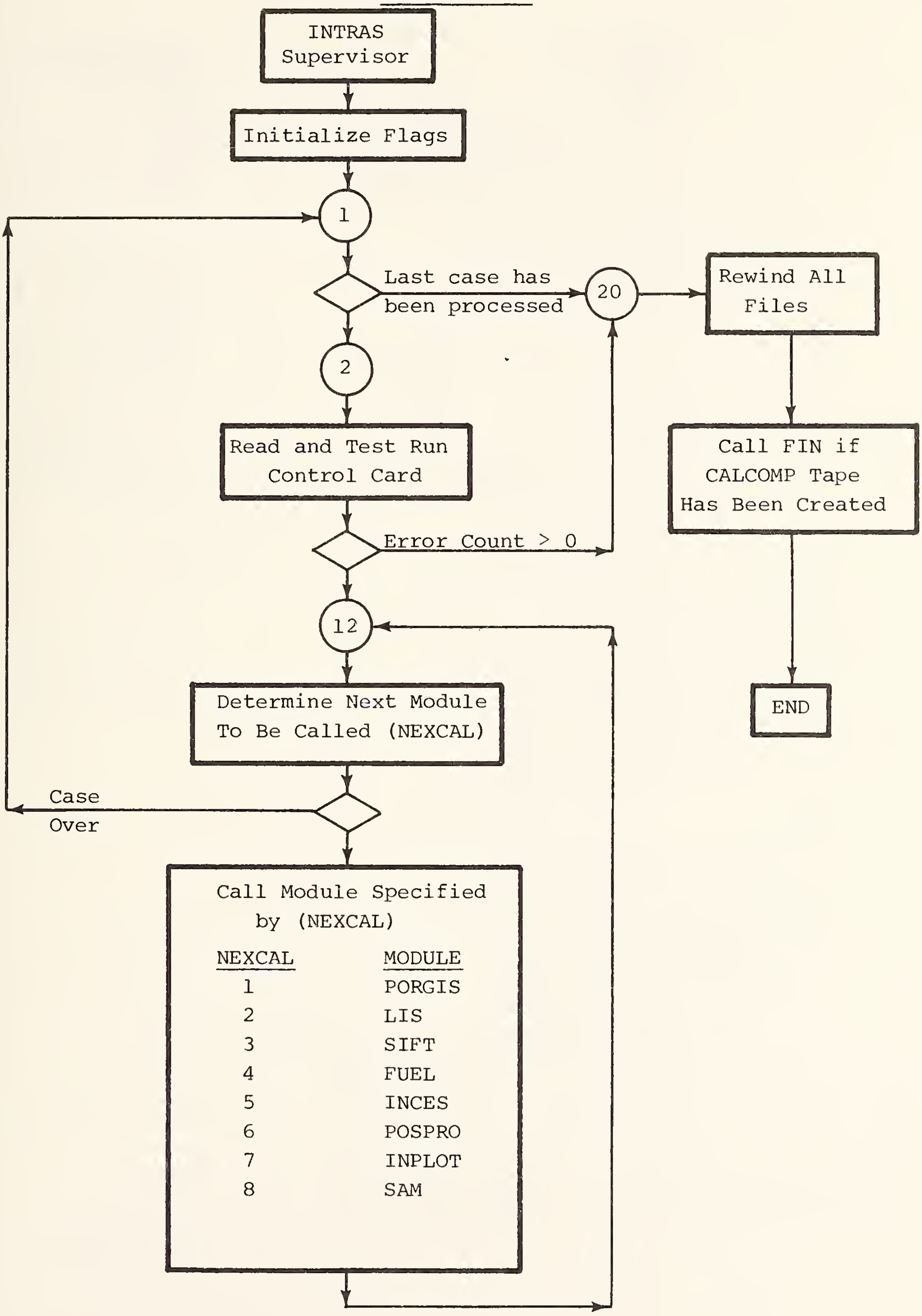


Figure 19: INTRAS Supervisor Logic

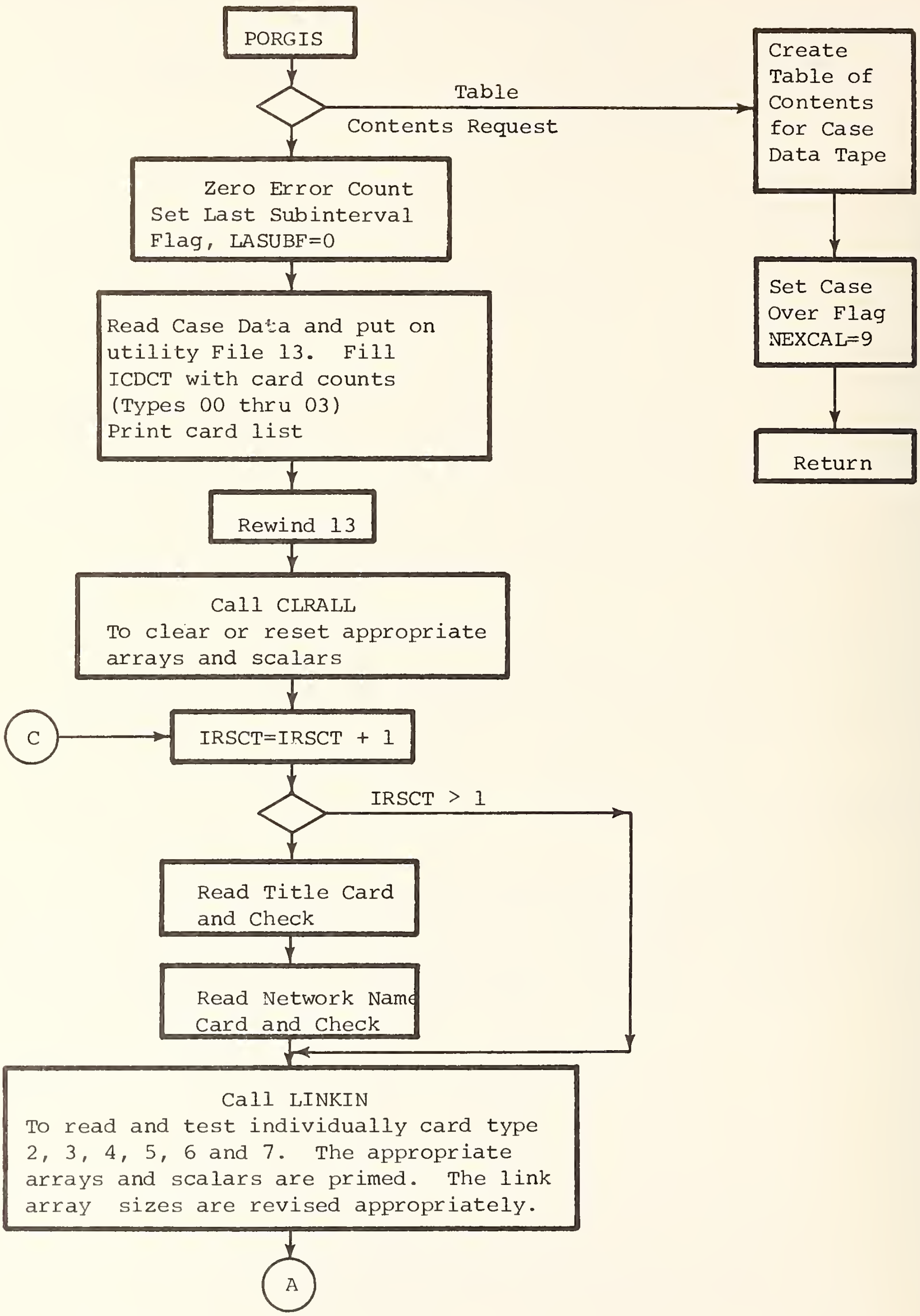


Figure 20: PORGIS Module Logic

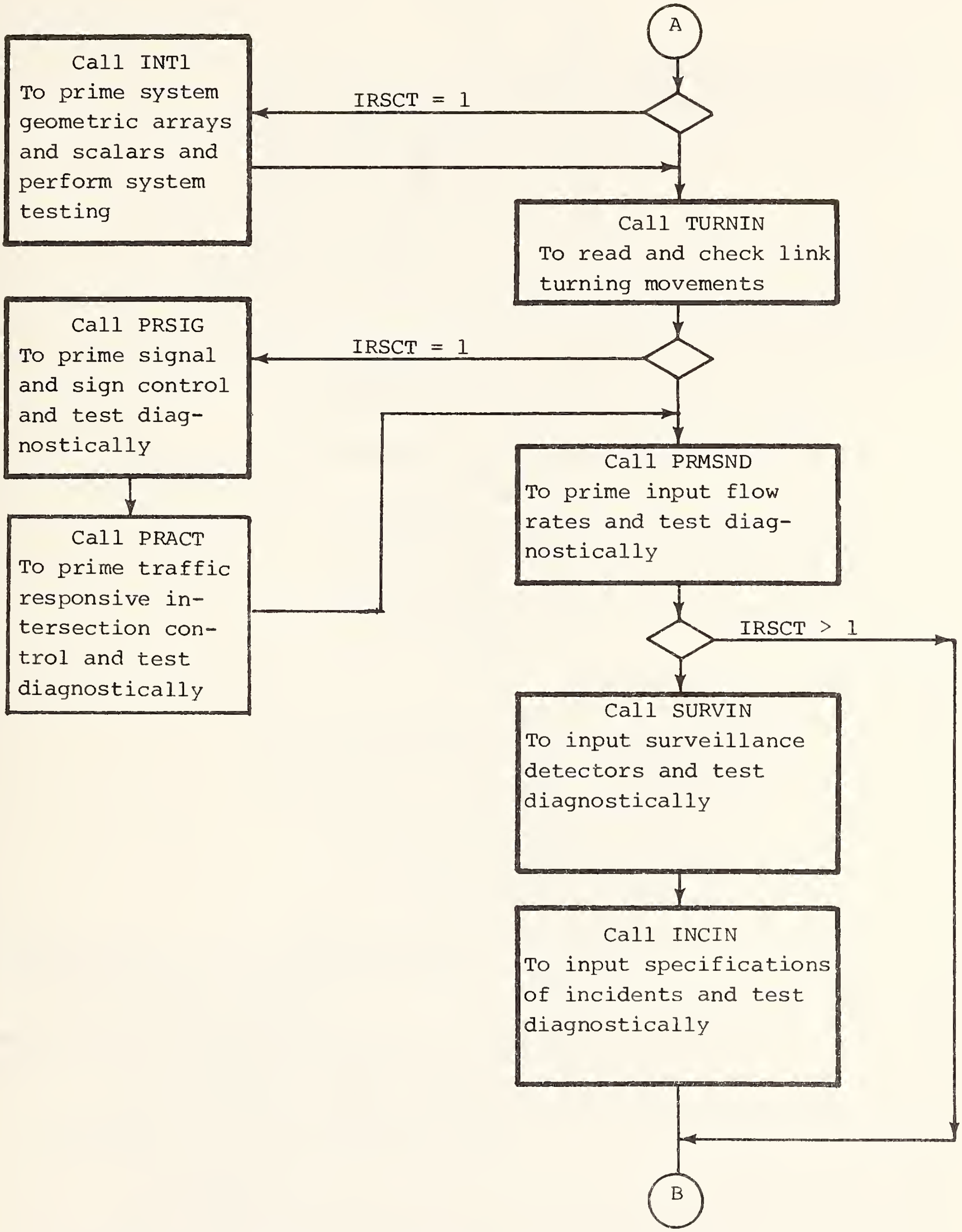


Figure 20: PORGIS Module Logic (continued)

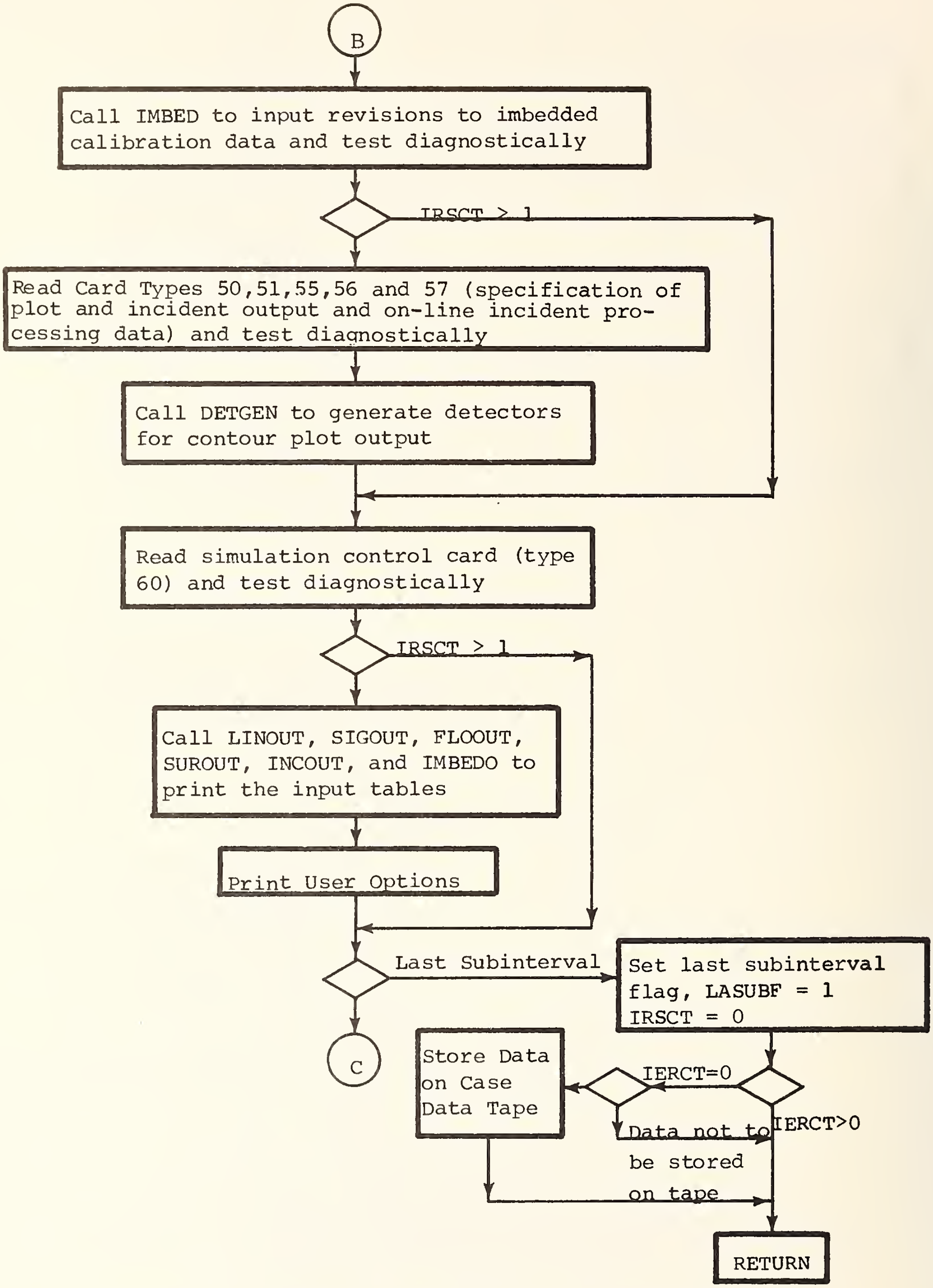


Figure 20: PORGIS Module Logic (concluded)

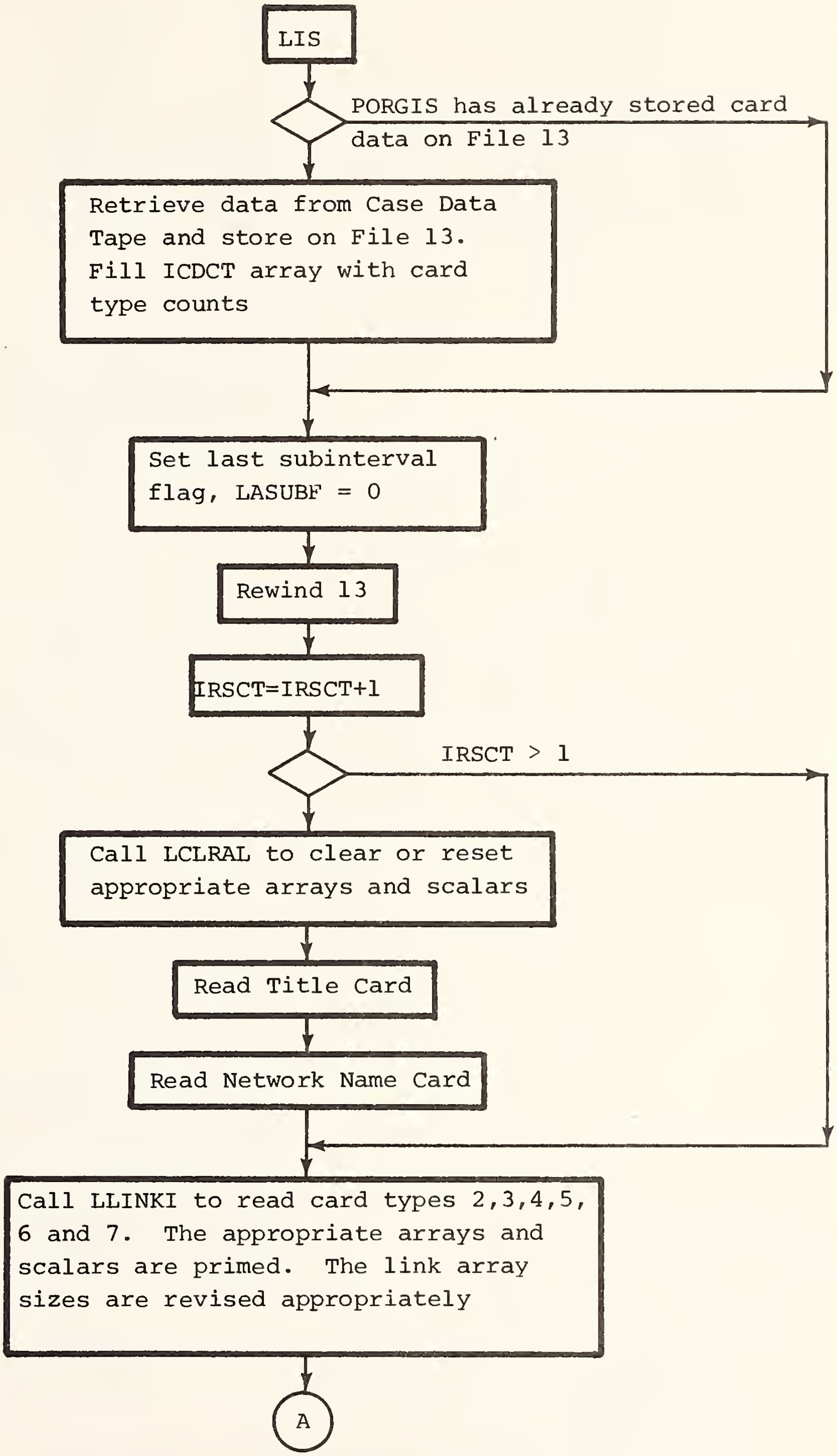


Figure 21: LIS Module Logic

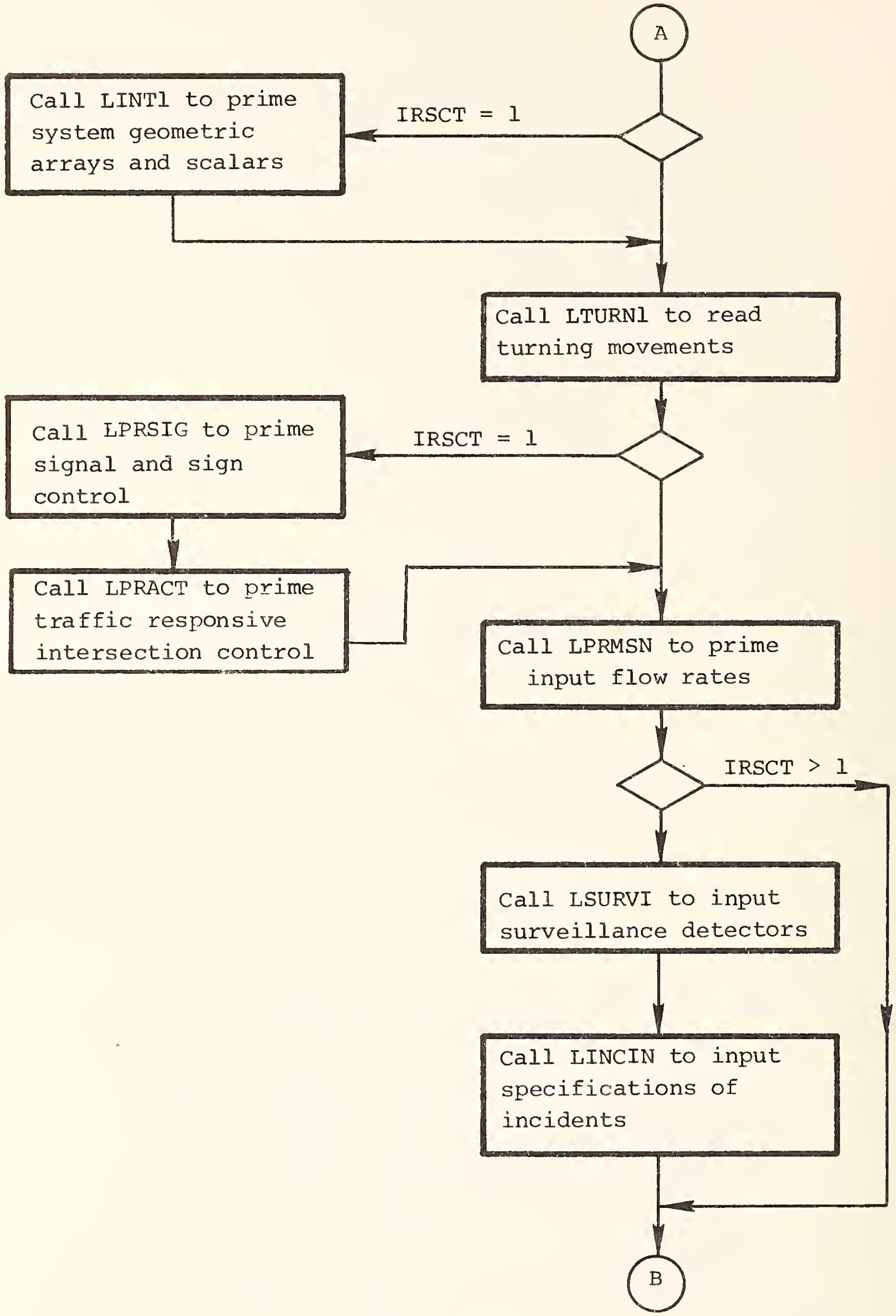


Figure 21: LIS Module Logic (continued)

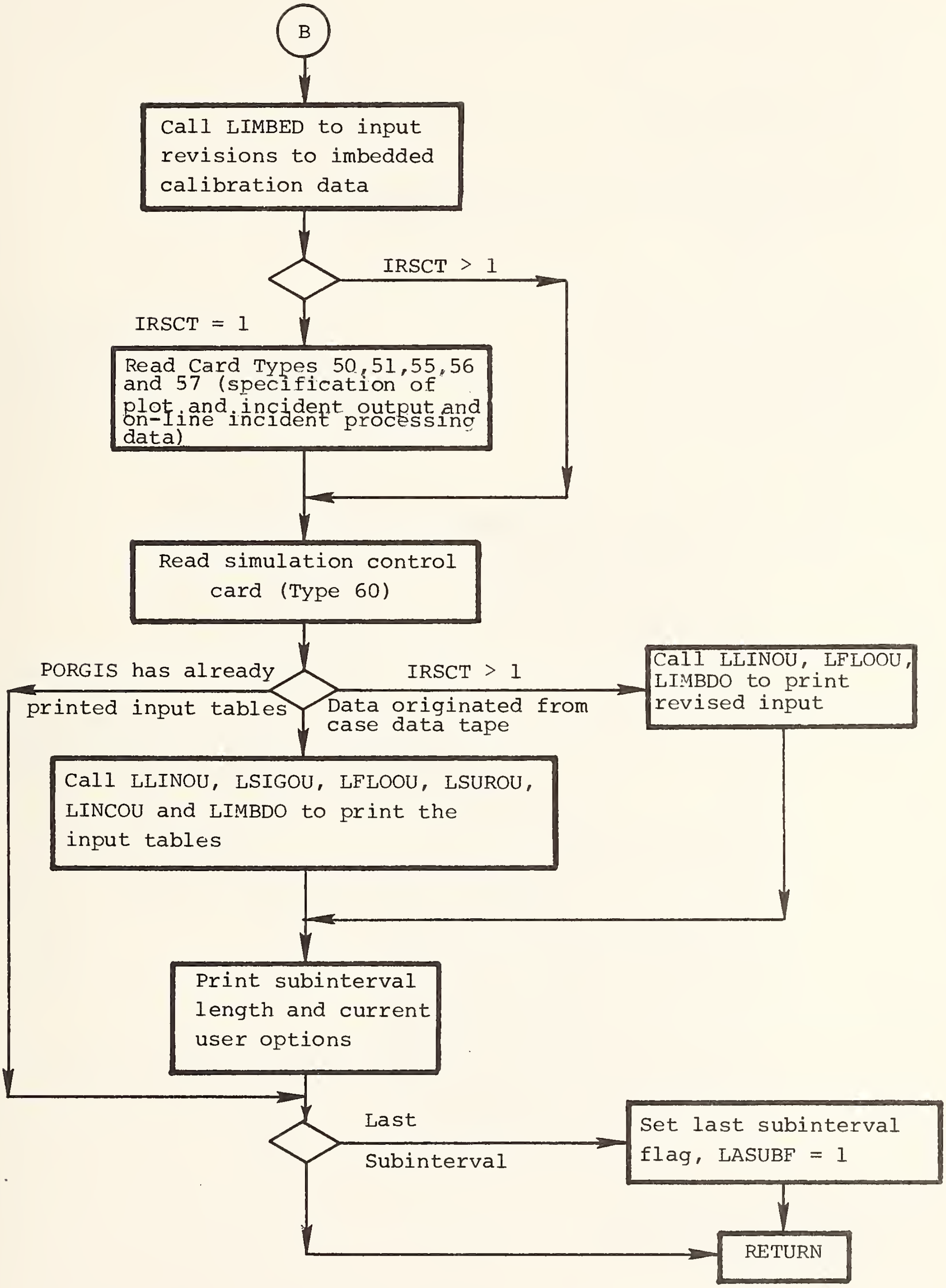


Figure 21: LIS Module Logic (concluded)

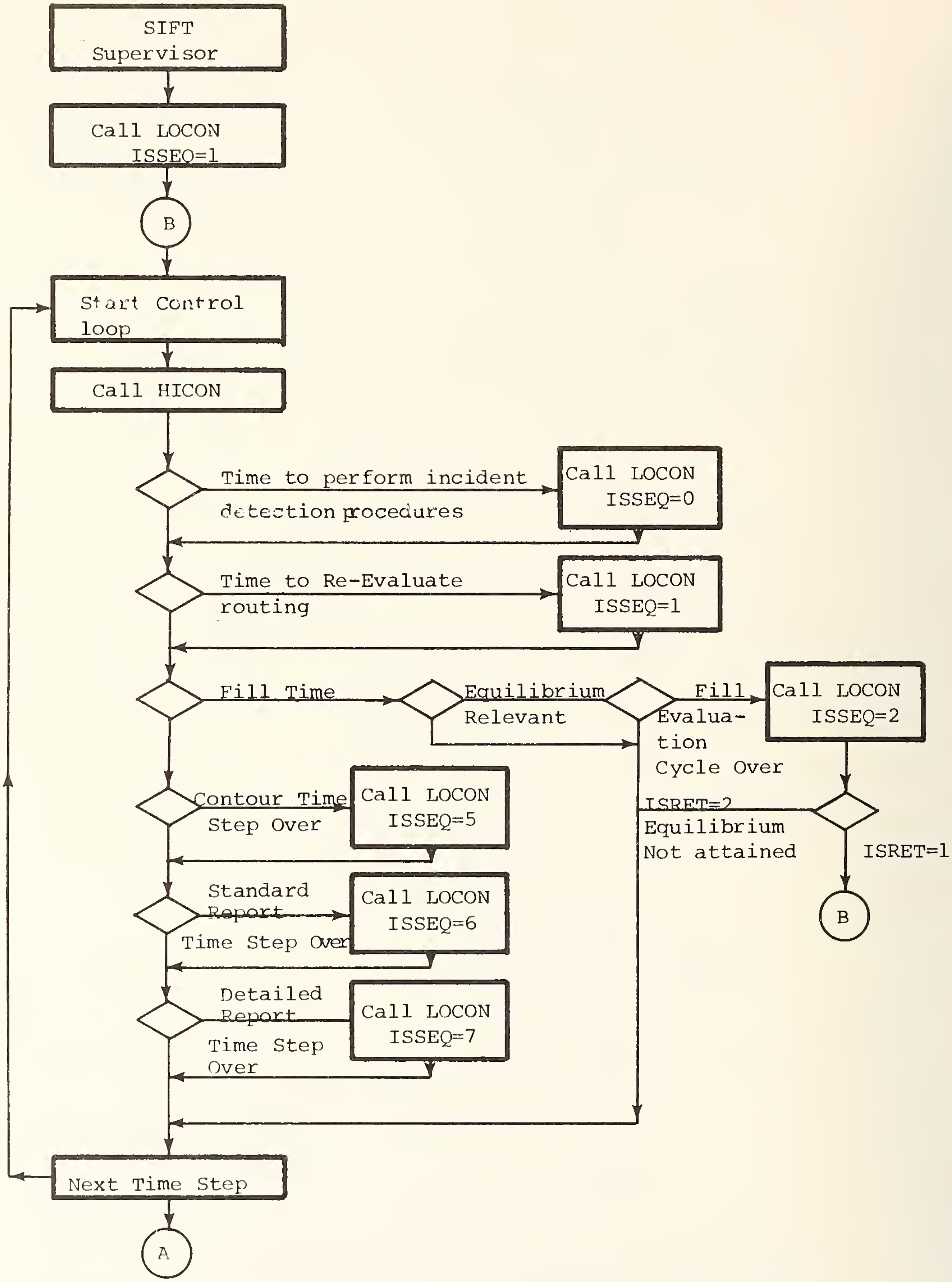


Figure 22: SIFT Supervisor Logic

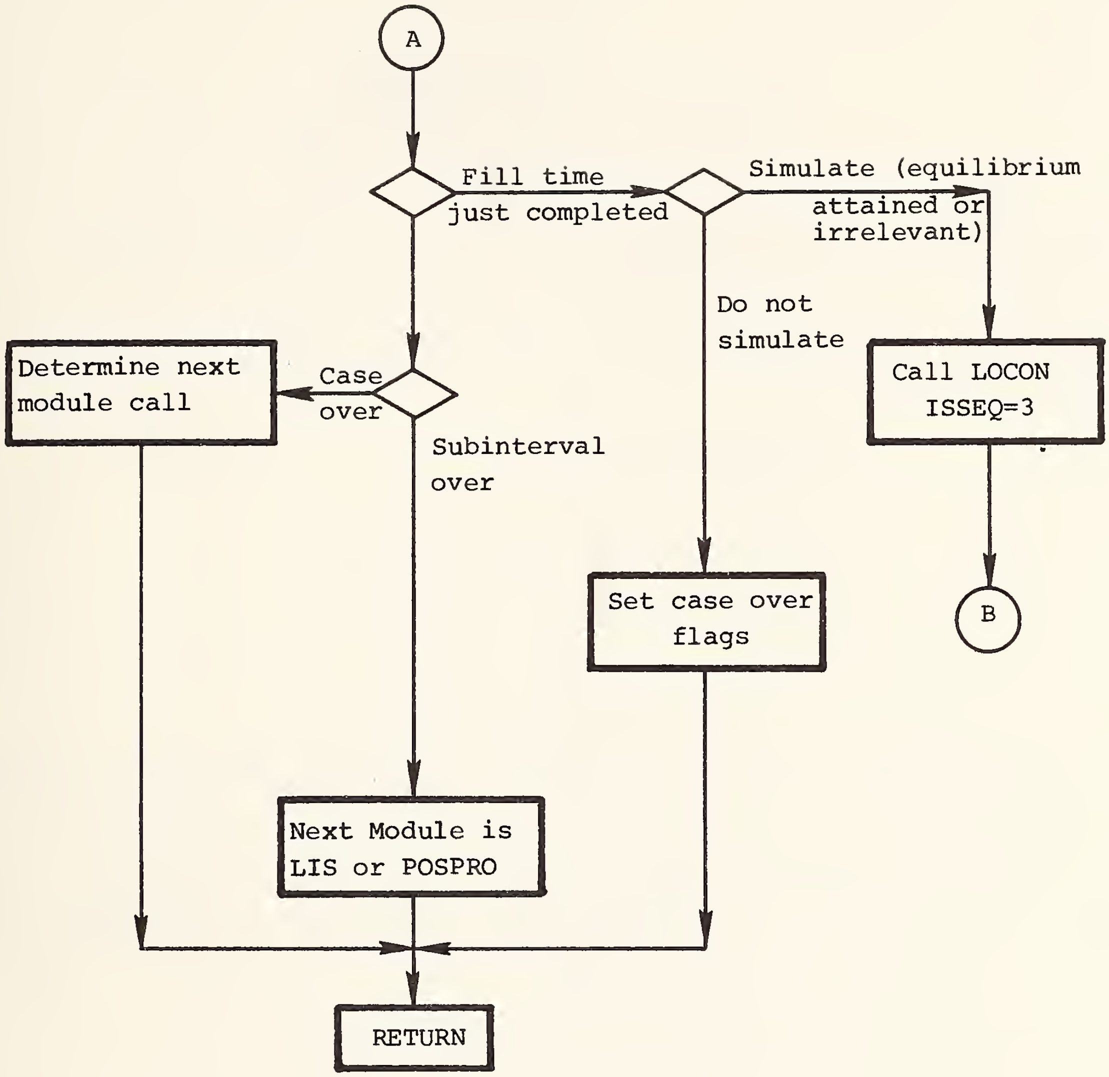


Figure 22: SIFT Supervisor Logic (continued)

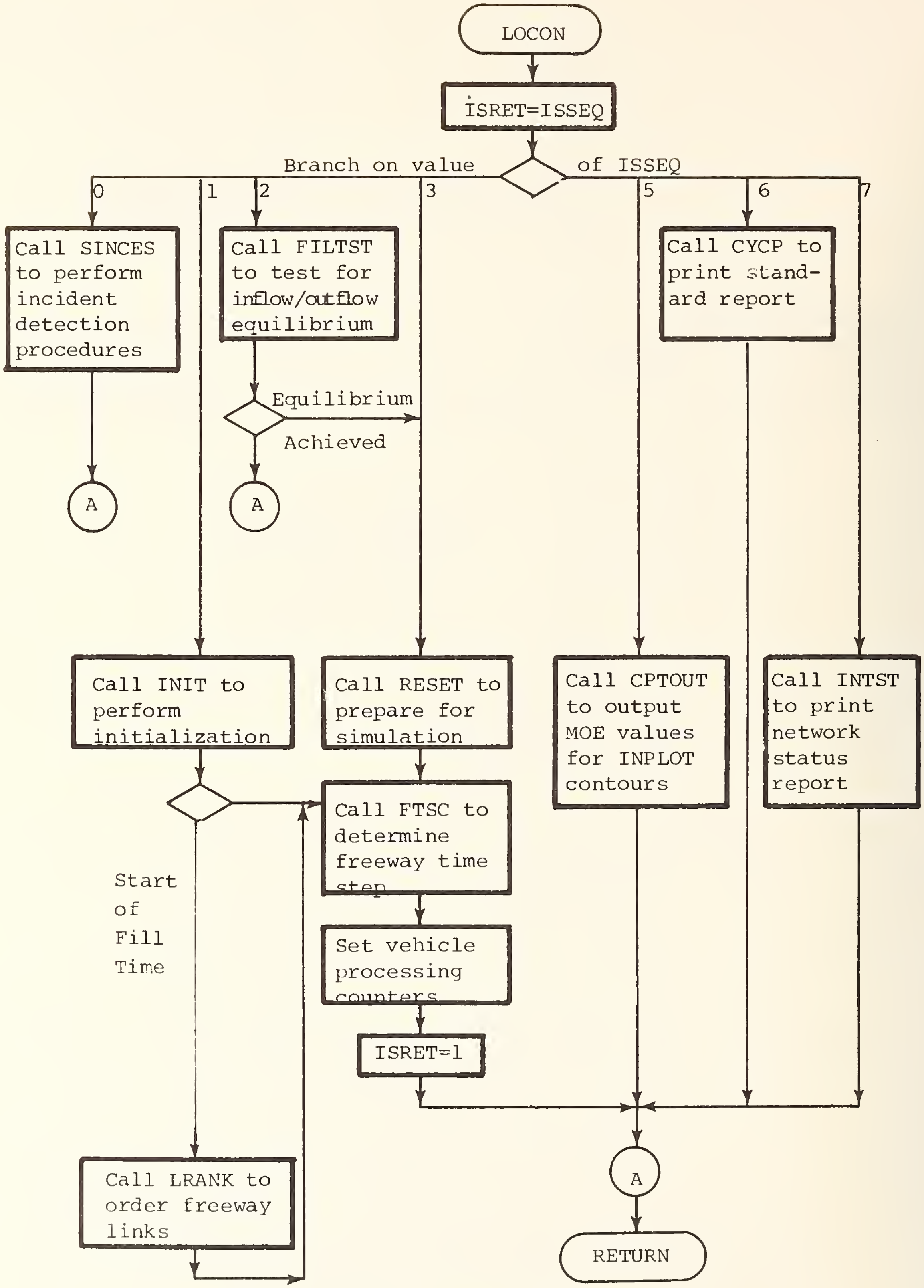


Figure 23: LOCON Suboverlay Logic

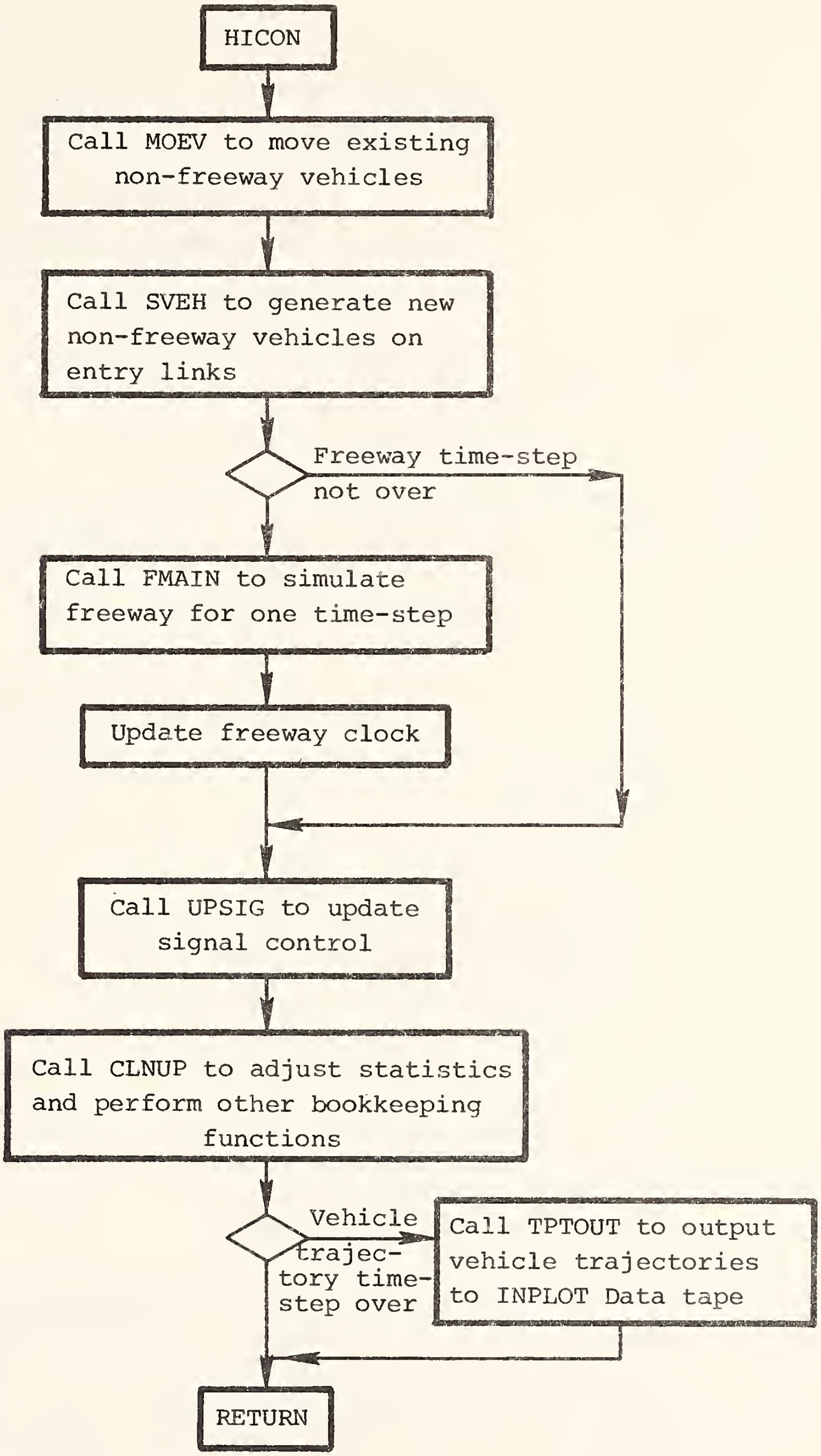


Figure 24: HICON Suboverlay Logic (concluded)

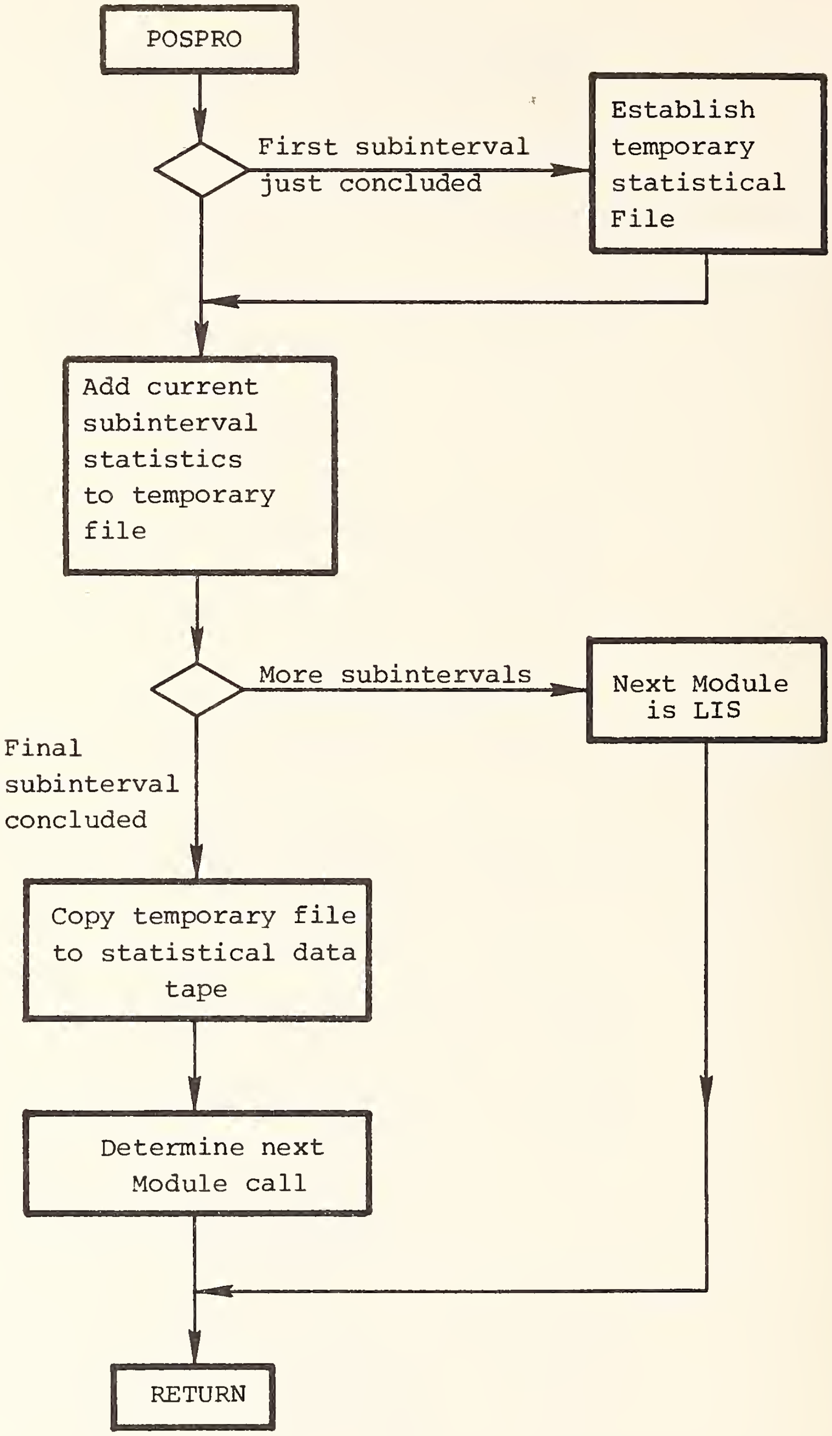


Figure 25: POSPRO Module Logic.

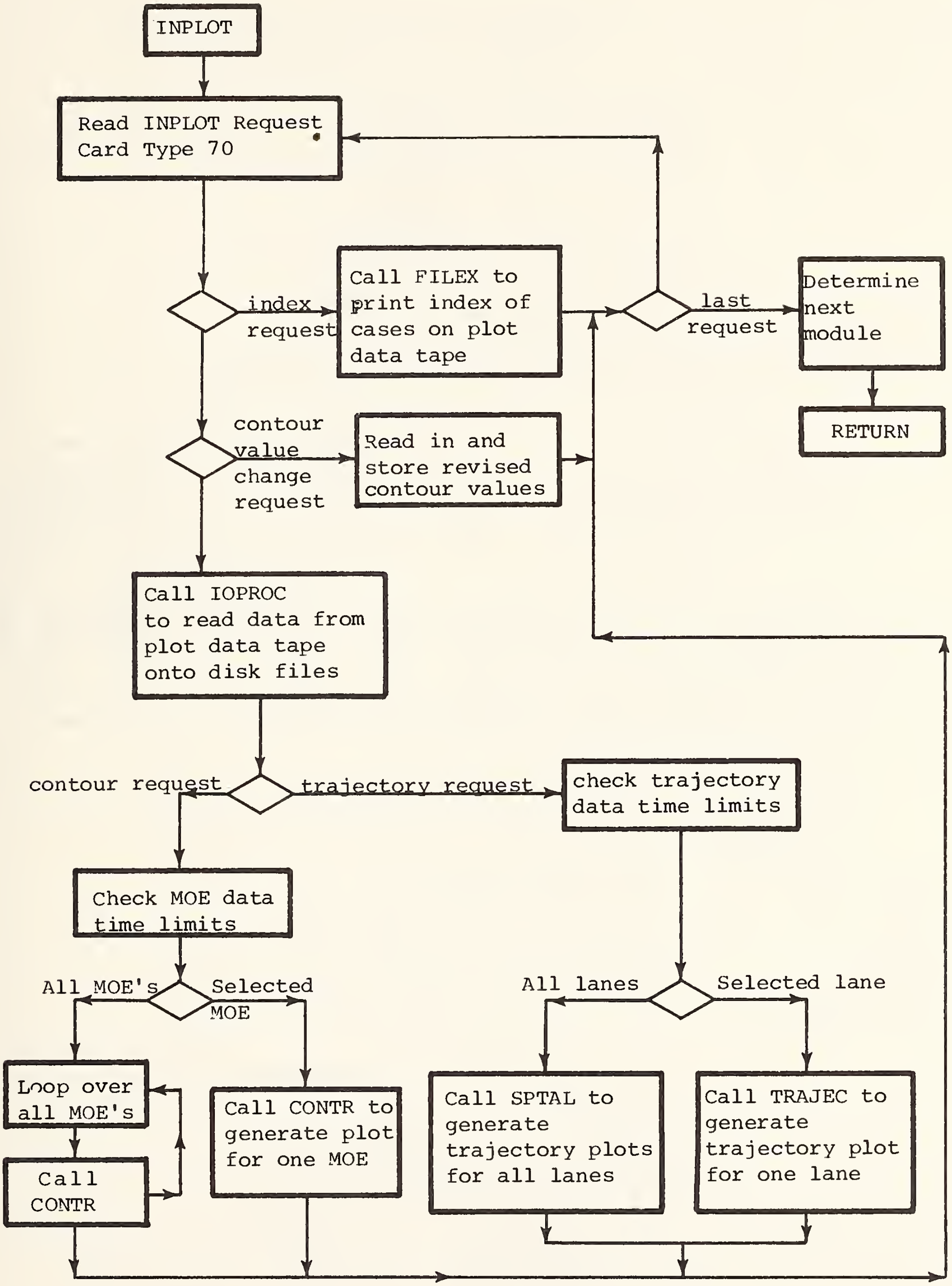


Figure 26: INPLOT Module Logic

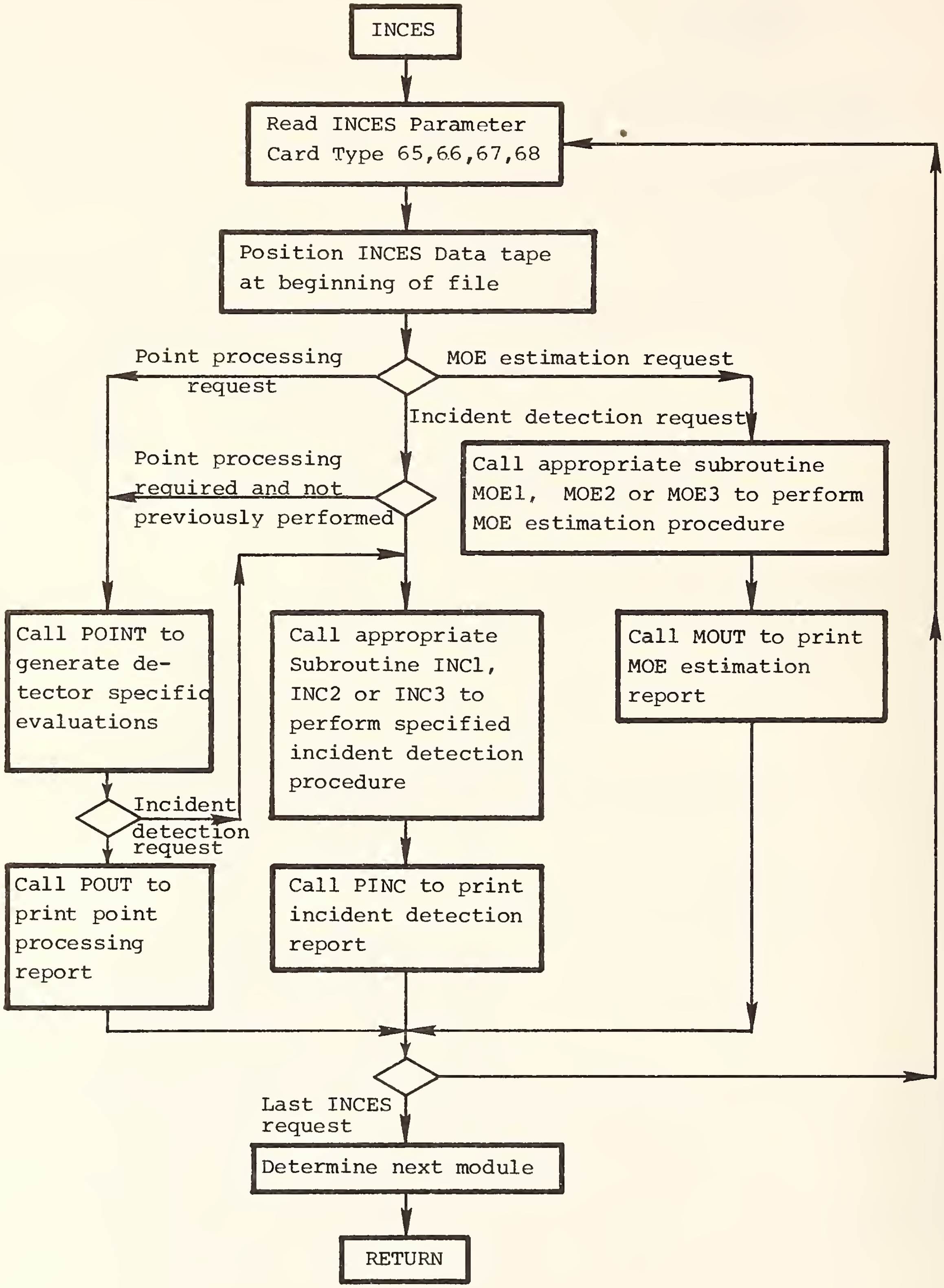


Figure 27: INCES Module Logic

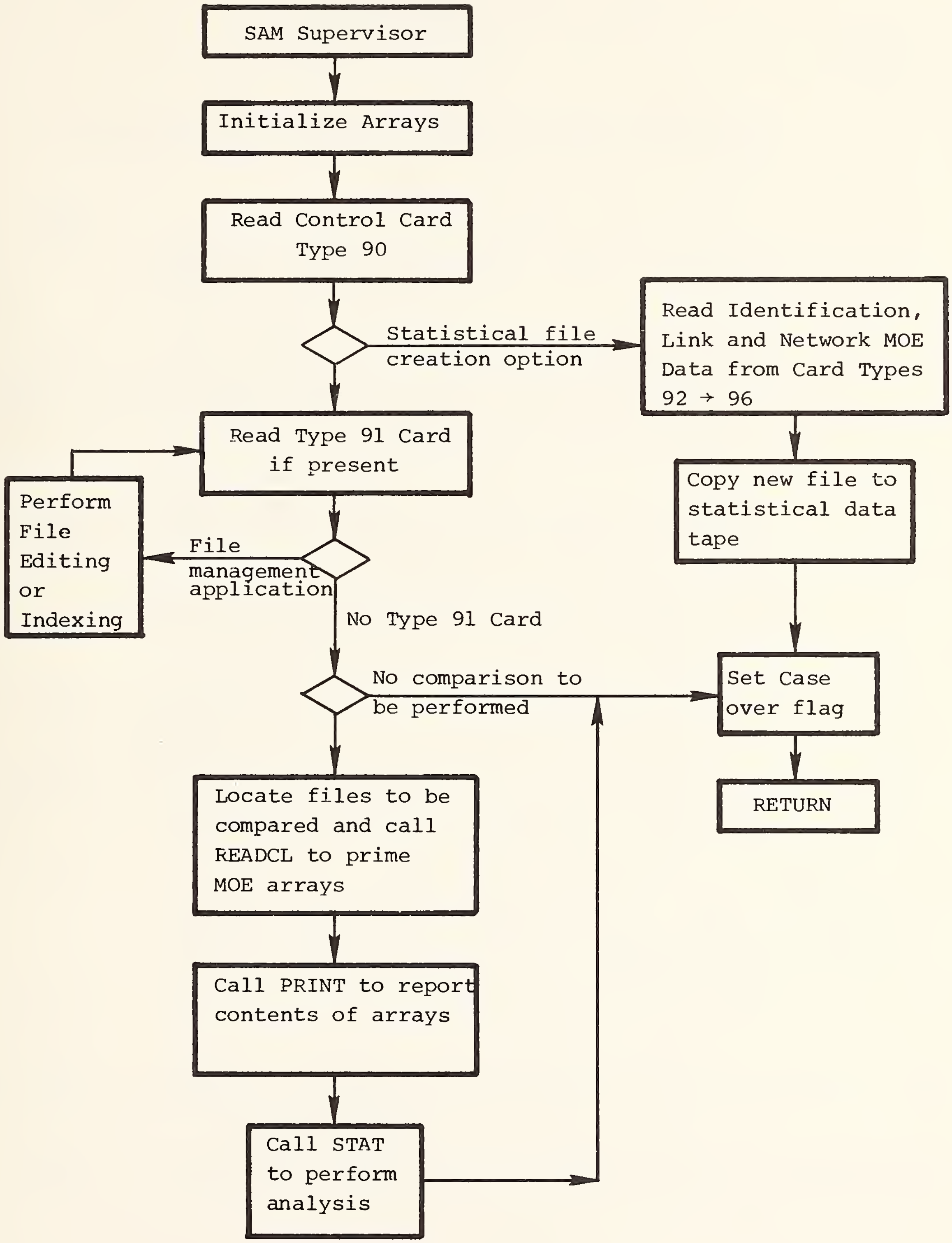


Figure 28: SAM Module Logical Flow

APPENDIX B

INTRAS Module Error Messages

Code	Message
1	Encountered Card Type P_1 while seeking Type 99. Will continue search for next Type 99 card.
2	Illegal Run Type - Column 2 of 99 card = 9 or 5.
4	Case Data Tape Sequence or Run ID negative - Columns 4 → 6 or 7 → 9 of 99 card negative.
5	Illegal value for Plot, Incident, Case Data or Statistical Tape Output Option Flag. Value of at least one of the flags in Columns 11, 12, 14 or 15 of 99 card is improper.
6	Incident Data Tape Old Run ID not specified. Column 2 of 99 card was input as 4 but no valid Run ID appears in Columns 10 → 18.
7	Incident Tape Table of Contents flag improperly specified. Column 21 on 99 card > 1.
8	SAM/INPLOT flag set for Valid Non-Zero Run Type. Column 24 of 99 card = 1 or 2 and Column 2 > 0.
9	Improper value for SAM/INPLOT flag. Column 24 of 99 card > 2, or = 0 with Column 2 = 0.

PORGIS Module Error Messages

Code	Message
100	End File has been encountered while processing PORGIS Input Cards.
101	Card Type P_1 has been encountered while processing PORGIS Input cards. If this card type is >60, then the run will terminate immediately. If card type = 99, then the last subinterval indicator (Column 24 =0 (blank)) was probably omitted from the last Type 60 card.
102	Incorrect number, P_1, of Type P_2 cards.
103	Card Type P_1 encountered when attempting to read Type P_2. Card type sequence error or missing required card type.
104	Invalid Time Step, Minimum=P_1, Maximum=P_2. One of the time steps specified on the Type 00 card is negative or >320 tenths of a second.
105	Card Type P_1 has been encountered for other than first subinterval. This card type is not allowed after first subinterval.
106	Total of all link types (Freeway P_1, Ramp P_2, Surface P_3) exceeds maximum P_4. The specified maximum is defined as the upper bound of certain link specific arrays (i.e., ENDNDS and IVFEET).
107	Invalid link (P_1,P_2) specified on card type P_3.
108	Node P_1, specified on Type P_2 card, is larger than maximum allowable node number P_3.
109	Undefined link type P_1 specified for link (P_2,P_3). Check Card Type 2. Processing of links continues.

Code	Message
110	Invalid link length P_1 specified for link (P_2,P_3). Card Type 2. Length is invalid if: Link length < 54 ft. Freeway link length > 9825 ft. Ramp or surface link length > 3275 ft. Processing of links continues.
111	No through link specified to freeway link (P_1,P_2). Card Type 2. Processing of links continues.
112	No first movement specified for ramp link (P_1,P_2). Card Type 2. Processing of links continues.
113	No downstream link specified for ramp link (P_1,P_2). Card Type 2. Processing of links continues.
114	Invalid mean desired free flow speed, P_1, for link (P_2,P_3). Card Type 2. Free flow speed is invalid if: Free Flow speed ≤ 0 Ramp free flow speed > 67
115	Invalid number of lanes, P_1, specified for link (P_2,P_3). Card Type 2. Invalid if: Number of freeway lanes > 5 Number of ramp lanes > 2 Number of surface lanes plus turn pockets > 5.
116	Invalid grade, P_1, specified for link (P_2, P_3). Card type 2. Invalid if grade < P_4 or grade > P_5.
117	Invalid radius of curvature, P_1, specified on link (P_2,P_3). Card Type 4. Invalid if $P_1 < 0$.
118	Invalid auxiliary lane code, P_1, for link (P_2,P_3). Card Type 5. Code must be ≤ 6.
119	No first auxiliary lane specified but second specified for link (P_1,P_2). Card Type 5.

Code	Message
120	Invalid auxiliary lane length specified for link (P_1,P_2). Auxiliary lane length, P_3, must be $\leq$ link length, P_4. Card Type 5.
121	Invalid downstream intersection type, P_1, specified for link (P_2,P_3). Card Types 5 and 6. Intersection type must be a number from 1 through 9.
122	Invalid mean queue discharge, P_1, specified for link (P_2,P_3). Mean queue discharge headway must be $>$ 0. Card Types 5 and 6.
123	Invalid lost time for first vehicle in queue, P_1, specified for link (P_2,P_3). Lost time must be $>$ 0. Card Type 6.
124	Invalid turn pocket size, P_1, specified for link (P_3,P_4). P_2 is (1,2) for (left,right) pocket. P_5 is maximum capacity of link. Invalid if: $\text{size} > \frac{\text{Link Length}}{20}$ Card Type 6.
125	Invalid channelization code, P_1, specified for link (P_2,P_3). Code must be $\leq$ 4. Card Type 6.
126	More than 4 approaches have been specified to node P_1. Card Type 2.
127	Receiving lane specified, during subinterval P_3, for vehicles in lane 1 of link (P_1,P_2). May be specified in first subinterval only. Original specification remains unchanged. Card Type 5.
128	Upstream node, P_1, of link whose through traffic opposes left turning traffic from link (P_2,P_3) specified in subinterval P_4. May be specified during first subinterval only. Card Type 6.
129	Turn pocket size for link (P_1,P_2) specified during subinterval P_3. May be specified during first subinterval only. Card Type 6.

Code	Message
130	One or both of the nodes of link (P_1,P_2) specified on Type P_3 card is larger than the maximum allowable node number P_4.
131	Invalid upstream node of link (P_1,P_2). Freeway entry node numbers range from 700 to 799. Surface entry node numbers range from 800 to 899. Card Type 2.
132	Number of links specified, P_1, exceeds maximum allowable, P_2. Card Type 2.
133	Exit ramp (P_1,P_2) not found. Card Type 2.
134	Exit ramp (P_1,P_2) specified incorrectly as either a freeway or a surface link. Card Type 2.
135	Non-freeway link (P_1,P_2) specified as downstream link for through movement from freeway link (P_3,P_1). Card Type 2.
136	Freeway link (P_1,P_2) not found. Card Type 2.
137	Ramp (P_1,P_2) is an on ramp and therefore must specify only a through downstream freeway link. P_3 Error Condition 1 First movement was not through 2 Receiving link was not a freeway link 3 Second movement was specified 4 Receiving link not found Card Type 2.
138	Link (P_1,P_2) specified on Card Type P_3 has been defined in geometry cards as another link type.
139	One or more of the downstream nodes of the receiving links for link (P_1,P_2) is/are out of range. Node numbers must be > 0 and $\leq$ NTOTN or $\geq$ 700 and < 900.

Code	Message
140	Downstream exit node of link (P_1,P_2) invalid. Exit node numbers range from 700 to 799 for freeway exits and from 800 to 899 for surface exits. Card Type 2.
143	Receiving link (P_1,P_2) for off-ramp (P_3,P_1) not found. Card Type 2.
144	Freeway link (P_1,P_2) has been specified as a downstream link to off-ramp (P_3,P_1). Card Type 2.
145	Surface link (P_1,P_2) specified link (P_2,P_3) as its downstream link. Card Type 2.

P_4	Error Condition
2	Link (P_2,P_3) not found on geometry cards.
3	Link (P_2,P_3) is a freeway link. Not allowed.
5	Link (P_2,P_3) is an off-ramp. Should be an on-ramp.

Code	Message
146	Surface link (P_1,P_2) designated (P_2,P_3) as its downstream link for through moving traffic. The model assumes (P_3,P_2) is the opposing link. Card Type 2.

P_4	Error Condition
2	Link (P_3,P_2) is a freeway link. Freeway and surface links may not connect directly.
3	Link (P_2,P_3) is a ramp but link (P_3,P_2) is a surface link.
4	Link (P_2,P_3) is a surface link but link (P_3,P_2) is a ramp.
5	Link (P_3,P_2) is an on ramp. Since link (P_1,P_2) is a surface link, link (P_2,P_1) cannot be a freeway link.

Code	Message
147	Surface link (P_1,P_2) specified link (P_3,P_2) as its opposing link. Card Type 6.

P_4	Error Condition
1	Link (P_3,P_2) not found.
2	Link (P_3,P_2) is a freeway link.
3	Link (P_3,P_2) is an on ramp.
4	Maximum allowable node number < $P_3 \leq 699$.
5	$P_3 \geq 900$.
6	$700 \leq P_3 < 800$. Must be ≥ 800 for non-freeway entry node.

Code	Message
148	Link (P_1,P_2) has been specified on a Type 8 card.

P_3	Error Condition
0	Invalid downstream or upstream node.
1	One or more negative turning percentages.
2	All turning percentages are zero.
3	Link not found.
4	Link (P_1,P_2) is a freeway link. There is no exit ramp but a non-zero exiting percentage has been specified.
5	Freeway link (P_1,P_2) has a (left,right) exit ramp and a non-zero (right,left) turning percentage.
6	Freeway link (P_1,P_2) has an exit ramp with a zero exiting percentage specified. Warning message, non-fatal.
7	Ramp link (P_1,P_2) has two receiving links specified and only one turning percentage. Warning message, non-fatal.
8	Ramp link (P_1,P_2) has one receiving link specified but more than one turning percentage.
9	Surface link (P_1,P_2) has more turning percentages specified than receiving links.

Code	Message
149	No through movement for ramp (P_1,P_2). On ramps must designate a through freeway movement. Off ramps must specify one or two movements, one of which must be through. Card Type 2.
150	Link (P_1,P_2) has designated P_3 as the lane receiving its lane 1 traffic in link (P_2,P_4). Link (P_2,P_4) does not have a lane P_3. Card Types 4 and 5.
151	P_1 = XX (a 2-digit number). Exit or entry nodes of the form 8XX and 7XX have both been specified. Card Type 2.
152	Early warning sign messages for freeway link (P_1,P_2). Card Type 2.

P_3	Error Condition
1	Invalid node, P_4, specified as a freeway-ramp junction. $0 < P_4 \leq$ NTOTN.
2	Location of early warning sign, P_4, specified but no corresponding off-ramp was identified.

Code	Message
	3 Node P_4 identified by early warning sign is not upstream node of an exit ramp.
	4 Early warning sign refers to node P_4 which is not downstream of this freeway link.
	5 Negative percent, P_4, specified as distance of early warning sign from upstream node.
	6 Node P_4 specified as freeway-ramp junction is not the downstream node of any freeway link.
153	On Card Type P_1, link (P_2,P_3), maximum number of statistical data stations was exceeded.
154	On Card Type P_1, link (P_2,P_3), invalid location P_4 of statistical data station was specified. Link length = P_5.
155	On Card Type 55, invalid detector mode flag P_1 was specified (must be 0 or 1).
156	Turning percentages not specified for link (P_1,P_2). Check type 8 cards.
157	Turning percentages not specified for a ramp or freeway link. P_1 is (1,2) for (ramp,freeway) link. Check type 8 cards.
161	Card read with type < 10. $P_1,\ldots,P_{10}$ are first 10 parameters from card in error. Program ignores card and looks for type 10 cards.
162	Negative control code or undefined control code (code = 6). P_1 = node number, P_2 = upstream node of approach link, P_3 = interval where error occurred. Card Type 10.

Code	Message
163	At node P_1, invalid reference offset P_2 specified to interval 1. Modulo cycle time reduced so that it is $\geq$ 0 and < cycle time. Card Type 10.
164	Invalid node number P_1. Card ignored, processing continued with next card. Card Type 10.
165	For node P_1, invalid upstream node, P_2, specified. Remaining checks for this link ignored. Processing continues with next link. Card Type 10.
166	No link found by FINDL for approach link specified by node pair (P_2,P_1). Remaining checks for this link ignored. Processing continues with next link. Card Type 10.
167	Maximum number of actuated control signals exceeded. P_1,...,P_{10} are first 10 parameters on card. Card ignored. Processing continues with next card.
168	Type 10 card input for node P_1 but no entry in SIGI array for this node. Card Type 10.
169	Entry in SIGI array for node P_1 but no Type 10 card was input for this node. Card Type 10.
170	No Type 10 cards were found.
171	No upstream nodes specified for node P_1. Processing continues with next card. Card Type 10.
172	At node P_1, only P_2 upstream nodes specified, but non-zero code P_3 specified for an upstream node P_4 for interval P_5. Card Type 10.
173	At node P_1, no interval duration was specified for interval P_2. Card Type 10.
174	At node P_1 invalid control code P_2 was specified for signed intersection (must be 0, 1 or 5). Card Type 10.

PORGIS (Cont.)

Code	Message
175	At node P_1 with upstream node P_2, a freeway link, an invalid control code was specified (must be 1 = green). Card Type 10.
176	At node P_1 with upstream node P_2 an invalid control code was specified (must be 0, 1 or 5 for ramp link or surface link with sign control). Card Type 10.
177	At node P_1 with upstream node P_2 no control code permitted left-turning traffic. Card Type 10.
178	Same as 177 for through traffic.
179	Same as 177 for right-turning traffic.
180	Approach (P_2,P_1) was not signalized.
181	End of file encountered while trying to read Type 20 or 21 card. Control returns to calling program.
182	Card Type <20 encountered. $P_1,...,P_{10}$ are first 10 parameters on card in error. Program ignores card and continues to look for Type 20 or 21 cards.
183	Card type >21 encountered before any Type 20 or 21 cards found. $P_1,...,P_{10}$ are first 10 parameters on card in error.
184	Maximum dimension of SNODE array exceeded. P_1 and P_2 are upstream and downstream nodes of link which caused error. Ignores card. Processing continues with next card. Card Type 20.
185	Invalid upstream node P_1 or downstream node P_2 specified (must have $P_1 \geq 700$, $P_2 \leq$ NTOTN). Ignores this link and looks at next link. Card Type 20.
186	Entry link (P_1,P_2) not found while processing Card Type 20. Check link geometry.
187	Percentages for vehicle types add up to > 100%. $P_1,...P_8$ = upstream and downstream nodes, flow rate and percentages for this link. Card Type 20.

Code	Message
188	On subsequent interval input, no entry in SNODE array was found for link (P_1,P_2). Link is ignored. Card Type 20.
190	No SNODE array entry for link (P_1,P_2). Card Type 20.
191	End of file encountered by PRSIG. Control returns to calling program.
192	For link (P_1,P_2) sum of percentages of vehicles on link lanes exceeded 100%. P_3,...,P_6 = percentages on Type 20 card.
193	Link (P_1,P_2) is an on-ramp but was signalized. Must have sign control. Card Type 10.
200	Detectors specified for link (P_1,P_2). Not allowed for surface or entry links. Card Type 25.
201	Invalid detector type P_1 for link (P_2,P_3). Card Type 25.
202	Negative loop length for type P_1 detector on link (P_2,P_3). Card Type 25.
203	Invalid lane placement, P_1, for detector on link (P_2,P_3). The indicated lane P_1 is not defined as either a through or auxiliary lane or as a turning pocket. Card Type 25.
204	Longitudinal placement (P_1 feet) of detector in lane P_2 of link (P_3,P_4) violates link boundaries. Loop length is P_5. Either the upstream or downstream end of the detector violates the lane geometric definition. Card Type 25.
205	Too many detectors. Maximum allowed is P_1. Card Type 25.

PORGIS (Cont.)

Code	Message
206	Invalid station number P_1 has been input for link (P_2,P_3) Must be $\leq$ 50. Card Type 25.
207	Duplicated station number P_1 specified on links P_2 and P_3. Card Type 25.
208	Improper coupled loop separation P_1. Must be between 10 and 40 feet. Value reset to 10 if $P_1 < 10$ or reset to 40 if $P_1 > 40$.

Code	Message
250	End of file encountered while looking for Type P_1 card. Control returns to calling program.
251	Type P_1 card encountered while looking for Type P_2 card. Action taken is to backspace and return if $P_1 > P_2$ and continue to look for P_2 if $P_1 < P_2$.
252	Invalid node P_1 or P_2 specified on Card Type P_3. Link ignored.
253	Invalid link (P_1,P_2) specified on Card Type P_4. If $P_3 = 0$, no link could be found. If $P_3 > 1$, link is not a freeway link. Link ignored.
254	Invalid incident code P_4 specified for lane P_3 of link (P_1,P_2). Card Type 30.
255	Incident code specified for non-existent lane P_3 on link (P_1,P_2). P_4 is actual number of lanes on link. P_5 and P_6 are actual first and second auxiliary lanes on link.
256	Dimension of INCID array exceeded. Link (P_1,P_2) caused error. Program ignores remaining operations and goes on to next link. Card Type 30.
257	Invalid index P_1, maximum index is P_2. Imbedded data Card Type is P_3. Data item ignored.
258	On Card Type P_2 a data list must be in (descending, ascending) order if $P_1 = (1,2)$. This requirement was violated.
259	On Card Type P_1 data list did not sum to 1000 (100 for $P_1 = 48$, 100 times number of lanes $P_1 = 47$).
260	Incident not within link (P_1,P_2) bounds. Card Type 30. P_3 is length of link. P_4 is upstream end location. P_5 is downstream end location.
261	DTCTR array dimension exceeded. $P_1 = I$, $P_2 =$ ICPLNK(I). DETGEN stops processing and control returns to calling program.

Code	Message
262	An invalid incident was specified for an entry link (P_1,P_2). Card type P_3.
268	EOF encountered while checking for a type 15 card.
269	Card type other than 15 or 16 found while reading types 15 and 16.
270	Invalid node P_1, which indicates controller location, input on card type P_2.
271	Actuated node P_1 previously specified on card type P_2.
273	Actuated specification for node P_1 exceeds the maximum P_2.
274	Invalid downstream node P_1 on card type P_2. This node indicates an approach referenced by controller P_3.
275	Invalid upstream node P_1 on card type P_2. This node indicates an approach referenced by controller P_3.
276	Cannot locate link (P_1,P_2) referenced on card type P_3 for node P_4.
277	Controller coordination code P_1 and red rest code P_2 disagree on card type 15 for node P_3.
278	Invalid cycle length P_1 for node P_2 on card type 15.
279	Invalid entry code P_1 for node P_2 on card type 15. P_1 must be 0, 1 or 2.
280	Invalid node P_1, which indicates node for which phases are input, specified on card type P_2.
281	Node P_1 referenced on card type P_2 not actuated.

Code	Message
282	Invalid phase P_1 for node P_2 on card type P_3. $0 > P_1 \leq 9$.
283	Phase P_1 for node P_2 referenced on card type P_3 has already been referenced.
284	Entry P_1 is negative on type P_2 card for node P_3, phase P_4.
285	Warning. Redundant entry $P_1 = P_2$ specified for phase actuation code P_3 on card type 16 for node P_5, phase P_4.
286	Beginning of yield P_1 occurs after end of yield P_2, phase P_4. Check type 16 card for node P_3.
287	Force-off P_1 less than minimum initial interval P_2, phase P_4. Check type 16 card for node P_3.
288	Illegal interval code P_1 for phase P_3. P_1 must be less than 4. Check type 16 card for node P_2.
289	Passage time P_1 less than minimum gap P_2 for phase P_4. Check type 16 card for node P_3.
290	Invalid force-off P_1 for phase P_3. Check card type 16 for node P_2.
291	Invalid yield point P_1, end of yield P_2, or offset P_3, for phase P_5. Check type 16 card for node P_4.
292	Both maximum green extension, P_1 and maximum green phase P_2 specified on card type 16 for node P_3, phase P_4.
293	Illegal values or combination of values for entries 11 through 14 (P_1 through P_4) for phase P_6. Check card type 16 for node P_5.
294	Invalid node P_1, which indicates node for which phase operations are being defined, was input on card type P_2.

Code	Message
295	Invalid phase P_1 for node P_2 on card type P_3. $0 < P_1 \leq 9$.
296	Phase P_1 for node P_2 referenced on card type P_3 has been previously specified.
297	Entry P_1 is negative on type P_2 card for node P_3, phase P_4.
298	Link index P_1 on card type 17 for node P_2, phase P_3 refers to link not specified on card type 15.
299	Lane P_1 does not exist on link P_2 as referenced on type 17 card for node P_3, phase P_4.
388	Improper vehicle length P_1 for on-line incident detection. Must be > 0. Card type 55.
389	Output incident or SAM tape to be produced. Therefore, a valid run identification number P_1 must exist. Card type 00.

Code	Message
390	Occupancy calculations for incident detection must be updated every P_1 tenths-of-a-second. Incident detection routines are called every P_2 tenths-of-a-second for incident check. P_2 must be $\geq P_1$, P_2/P_1 must be > 20 and P_2 must be an integer multiple of P_1. Note: The inputs to be changed are on the type 55 card; Contents of Cols. 13-18 should equal or exceed contents of Cols. 7-12.
391	Incident detection algorithm number P_1 must be between 1 and 3, is out of range. Card type 56.
392	Station to be used for incident detection input in incorrect order. Stations must be input in upstream to downstream order -- station P_2 was input before station P_1 on type 25 card -- or P_2 could not be located downstream of P_1. Check station numbers on type 25 card and/or sequences on type 57 card.
394	On-line incident detection has been specified; therefore, the user <u>must</u> specify a non-zero freeway time step equal to 10 tenths-of-a-second. Card type 00.
395	Number of parameters P_1 input for use in desired incident detection algorithm is out of range (must be between 1 and 18). Card type 56.
396	No detectors have been found at station P_1; this station has been input for incident detection. Doppler radar detectors are not permitted for incident detection. Card type 25 and/or card type 56.
397	Station P_1 is to be used for incident detection and occupies a non-freeway link.

Code	Message
398	Station number P_1 occurs in more than one series of incident detection stations on type 57 card. This is not permitted.
399	Incident data tape to be produced. Therefore, freeway time step P_1 must be equal to 10 tenths-of-a-second. This value is reset internally and simulation is <u>not</u> aborted. Card Type 00.

LIS Module Error Messages

Code	Message
400	Required data case not found on tape. P_1 is sequence number requested on Type 99 card. P_2 is run identification number requested on Type 99 card. Case is aborted.
401	Sequence number found but ID did not match run ID on Type 99 card. P_1 is sequence number of case. P_2 is run ID on Type 99 card. P_3 is run ID on tape. Case is aborted.

FUEL Module Error Messages

Code	Message
550	Input code P_1 for vehicle type P_2, speed P_3, is incorrect. Case is aborted.
551	Vehicle type P_2 corresponding to input code P_1, speed P_3, is incorrect. Case is aborted.
552	Speed P_3 corresponding to input code P_1, vehicle type P_2, is incorrect. Case is aborted.

SIFT Module Error Messages

Code	Message
600	LNEND array overflow. More than 3 incidents (including end of auxiliary lane) on lane P_1, link P_2, at time P_3. Maximum of 3 incidents allowed. Simulation aborted.
602	Logical collision in lane P_1 of link P_2 at time P_3. P_4 = (1,2) for (Ramp,Surface) link. Vehicle is stopped and simulation will continue.
604	P_3 vehicles discharged from ramp link P_1, lane P_2 in one time step. Informative message--unusually high flow rate.
605	Vehicle P_1 on link P_2, link type P_3, lane P_4, had invalid queue position P_5. Queue position must be $\geq$ 1 and $\leq$ 4, where 4 indicates any position beyond 3. Simulation aborted. Program malfunction. Rerun with revised initial random number seed.
606	Vehicle type P_2 came to stop at position P_3 in lane P_1, trapped at incident. No action.
607	Logical collision in lane P_1, vehicle type P_2, location P_3 in link where incident is currently active. No action.
608	Vehicle about to discharge from link P_1, link type P_2, lane P_3, turn code P_4. No lane found in which vehicle could avoid collision with upstream vehicle. Subroutine TSTSAT indicates there is room in link but subroutine LANES cannot find room. Program malfunction. Rerun with revised initial random number seed. Simulation aborted.
609	Zero spacing between leader vehicle P_1 and follower P_2 after processing P_1. Follower P_2 has positive velocity P_3. Link is P_4. Lane is P_5. This error represents a self-correcting program malfunction if P_3<5 fps. Fatal otherwise. Rerun with revised initial random number seed.

Code	Message
611	Link P_1 in COMMON/LENVI/ with downstream node P_2 was not found as approach in SIGI array to node P_2. Job aborted.
612	Current lane P_1 of subject vehicle does not match any LLOR array element. LLOR(1) through LLOR(5) equals P_2 through P_6. Job aborted.
613	No space for new freeway vehicles in VF array. MNLV should be increased.
614	No space for new ramp vehicles in VR array. MNLV should be increased.
615	No space for new surface vehicles in VS array. MNLV should be increased.
616	No room for new vehicles on surface entry link (P_1,P_2). MNLV should be increased.
617	No more vehicle space at time P_1. MNLV should be increased.
631	More than one approach to node P_1. Actuated nodes may only have one approach. Simulation aborted.
632	Invalid metered signal code for node P_1. Check type 10 card.
633	Invalid basic signal code for node P_1. Check type 10 card.
634	Invalid movement code for node P_1. Check type 10 card.
635	Invalid capacity. Capacity must be greater than zero. Check type 10 card for node P_1.

Code	Message
636	Upstream node P_1 and downstream node P_2 given on type 10 card to define detectorized link used in measuring freeway performance do not correspond to any defined freeway link in network. Check type 10 card for node P_3.
637	Lane P_1 containing detector to be used in measuring freeway performance is invalid. Check type 10 card for node P_2.
638	Link (P_1,P_2) to be used in measuring freeway performance is not detectorized; it must be. Check type 10 card for node P_3 for errors or detector specifications on type 25 card.
639	Detector described on type 10 card for node P_1 by lane P_2, and position P_3 does not match any detector established by a type 25 card. Check type 10 and 25 cards.
640	Invalid speed threshold for node P_1. Check type 10 card.
641	Invalid metering headway for node P_1. Check type 10 card.
642	Improper speed thresholds or metering headways specified for node P_1. Speed thresholds must be in descending order and metering headways must be $>$ 0. Check type 10 card.
643	Unreasonable minimum acceptable gap specified for node P_1. Check type 10 card.
644	Merge point for surface link P_1 with actuated signal (plus ramp link) and detectorized freeway link P_2 used to measure freeway performance not found. Check network geometry.

SIFT (Cont.)

Code	Message
645	Improper value P_1 specified for percentage of traffic to be diverted. Check type 10 card for node P_2.
646	Improper diversion path specified for node P_1. Check that first and second nodes in path are downstream nodes of off-ramp and surface links, respectively, and that last node is a surface exit on a freeway node at the downstream end of an on-ramp. The path must be consistent with the network geometry established by type 2 cards. Check Card Type 10.
647	Vehicle P_1 on link P_2 of type P_3 (P_3 = (1,2) for (ramp,surface) links) was diverted from node P_4. At the current time, it is not on a link in the diversion sequence. This is a non-fatal message.
651	Vehicle P_1 of type P_2 was not processed this time step. Type P_2 = (1,2,3) for (freeway,ramp,surface) links. This fatal error represents a program malfunction. Rerun with revised initial random number seed.
660	Freeway entry link P_1 cannot be found in SNODE array. This fatal error represents a program malfunction. Rerun with revised initial random number seed.
680	Vehicle assigned to non-existent lane P_1 on off-ramp link P_2. This fatal error indicates a program malfunction. Rerun with revised initial random number seed.
681	Vehicle P_1 entering off-ramp P_2 too fast. Trajectory adjustment fails. Ramp either too short or leader vehicle too close. P_3 = Target stopping point in feet from upstream end of off-ramp; P_4 = Initial position; P_5 = Initial speed, fps. This fatal error indicates program malfunction or very short ramp link. Rerun with revised initial random number seed.

INCES Module Error Messages

Code	Message
700	Tape to be used for detector output is empty, user indicated that tape was not empty. <u>This is not a fatal error</u>. Card type 99.
701	Unexpected end of file on incident data tape. Processing aborts.
702	Unable to find run ID P_1 on incident data tape. Run aborted. Either wrong tape or wrong run ID number on type 99 card.
703	Unexpected end of file on reading INCES card data. Card type P_1 expected. Run aborts.
704	Card type P_1 expected in INCES input, but type P_2 encountered. Recheck all INCES data cards and card sequences. Run aborts.
705	On card type 65, invalid detector mode flag P_1 was specified (must be 0 for digital or 1 for analog detectors).
706	Occupancy calculations for incident detection must be updated every P_1 tenths-of-a-second. Incident detection routines are called every P_2 tenths-of-a-second for incident check. P_2 must be $\geq P_1$, P_2/P_1 must be > 20 and P_2 must be an integer multiple of P_1. Note: The inputs to be changed are found on the type 65 card. Contents of Cols. 13-18 should equal or exceed contents of Cols. 7-12.
707	Improper number P_2 of parameters for algorithm P_1. Number input must be between 1 and 18. Card type 65.
708	Improper vehicle length P_1 for point processing or incident detection. Must be > 0. Card type 65.

INCES (Cont.)

Code	Message
709	Improper point processing code P_1. Must be 0 or 1. Card type 65.
710	Improper MOE code P_1. Must be 0 or 1. Card type 65.
711	Improper incident detection algorithm number P_1. Must be between 1 and 3. Card type 66.
712	Improper MOE algorithm number. Must be between 1 and 3. Card type 67.
713	Station number P_1 occurs in more than one series of incident detection stations on card type 68. This is not permitted.
714	Station P_1 is to be used for incident detection and occupies a non-freeway link. Run aborts. May have to change data station sequence. Card type 68.
715	No detectors have been found at station P_1. This station has been input for incident detection. Check station number of card type 68.
716	Station to be used for incident detection input in incorrect order. Stations must be input in upstream to downstream order -- station P_2 was input before station P_1 on card type 68 -- or P_2 could not be located downstream of P_1. Check sequence on card type 68.

INPLOT Module Error Messages

Code	Message
800	End of file encountered while searching for Type 70 card. Run aborted
801	Card Type P_1 encountered while searching for Type 70 card. If $P_1 < 70$, continue to look for Type 70 card. If $P_1 > 70$, abort run.
802	End of file encountered on data tape while searching for data for plot request Type P_1 for case with run identification number P_2. Program looks for next Type 70 card, if any.
803	Plot requested with maximum time P_1 sec., but data on tape only goes to P_2 sec. Run identification number is P_3. Program looks for next Type 70 card, if any.
806	While processing trajectory plot for case P_1, VPOS table overflowed; i.e., too many vehicles in system. Action - goes on to next case. Must enlarge VPOS array in COMMON /PLT/. Presently, VPOS(250,40) allows for 250 vehicles. Must also set MAXV = maximum number vehicles allowed (set in INPLOT). Common /PLT/ must be changed in routines INPLOT, AXPLOT, COMPCT, CNTR, CPLOT, FILEX, IOPROC, PAGE, PATH, SEARCH, SPTAL, TPLOT, TRAJEC. Must also enlarge IDVEH array to maximum number vehicles allowed. Also in CONTR and CPLOT, must enlarge MOE array which is equivalenced to VPOS array. Presently MOE is MOE(40,250), allowing for up to 250 MOE stations.
807	While processing contour plot for case P_1, MOE table overflowed; i.e., too many stations in system. Simulation aborted. Must enlarge MOE, VPOS and IDVEH arrays, see error message 806.
808	No path could be found from upstream node P_1 to downstream node P_2. Case is P_3. Action - goes on to next case. Reexamine Type 70 card.

Code	Message
809	Dimension of NDLIST exceeded (path of more than 20 nodes requested). P_1 = upstream node; P_2 = downstream node; P_3 = case ID. Reexamine Type 70 card, input path of at most 20 nodes.
810	Points out of range of specified scale when drawing roadway section boxes. P_1 = upstream node; P_2 = downstream node. Reexamine Type 70 card, adjust x or y axis size. Plot aborted, program goes on to next case.
811	Bad time scale specified - exceeds axis - plot aborted, program goes on to next case. P_1 = axis length (y-axis for contour plot, x-axis for trajectory plot) P_2 = scale specified by user (tenths-of-a-min/inch) P_3 = start time (min) P_4 = stop time (min)
812	Invalid lane number (for trajectory plots) specified for case P_1. Re-examine type 70 card. Plot aborted, program continues with next case.

SAM Module Error Messages

Code	Message
900	Card type P_1 was expected when end file was encountered. Data cards for statistical module are not complete.
901	Card type P_1 was expected when card type P_2 was encountered. Data cards out of order.
902	Number of files deleted (located on input tape) is P_1. File P_2 could not be located. (File P_2 does not exist on this tape. Eliminate P_2 from desired file to be deleted or change to other file number.)
903	File P_1 was designated for statistical comparison but could not be located on input tape. Change file number or change input tape.
904	The number of freeway links in network P_1 is P_2. The number of freeway links in netwrok P_3 is P_4. P_2 is not equal to P_4. Unequal number of freeway links. WARNING - action is to not perform link specific analysis for freeway links.
905	For network P_1 number of ramp links is P_2, number of surface links is P_3. For network P_4 number of ramp links is P_5, number of surface links is P_6. Either $P_2 \neq P_5$ or $P_3 \neq P_6$; i.e., unequal number of corresponding ramp or surface links. WARNING - action is to not perform link specific analysis for non-freeway links.
906	Number of subintervals in network P_1 is P_2. Number of subintervals in network P_3 is P_4. $P_2 \neq P_4$. Unequal number of subintervals. Therefore cannot perform analysis.

APPENDIX C

COMMON /A1/

MNLV	Number of (words/halfwords) available for storage of link and vehicle arrays.
NLV(MNLV)	INTEGER*2 Array containing all link and vehicle data.

Six two-dimensional arrays are equivalenced to NLV. The size of each of these arrays must be less than or equal to MNLV. Descriptions of the link arrays, LNKF, LNKR and LNKS for freeway, ramp and surface links and of the vehicle arrays VF, VR and VS for freeway, ramp and surface vehicles are provided on the following pages. Each vehicle array must be declared INTEGER. Also, each link and vehicle array must be declared INTEGER*2 in IBM version of INTRAS.

LNKF (K,L) Array INTEGER*2

K	Description
1	Number of through lanes
2	1/3 the length of the freeway link (feet)
3	Code number of auxiliary lane 1 6 = Left lane 1 7 = Left lane 2 8 = Right lane 1 9 = Right lane 2
4	1/3 the length of auxiliary lane 1 (feet)
5	Code (0,1,2) if lane is (acceleration, deceleration, full)
6	Same as for K = 3 for second auxiliary lane
7	Same as for K = 4 for second auxiliary lane
8	Same as for K = 5 for second auxiliary lane
9	Mean free flow speed, fps
10	Grade code
11	Code (0,1) if grade (positive, negative)
12	Percentage of total volume on link L which leaves freeway at downstream node
13	Identifying number of ramp link servicing vehicles leaving freeway, if any
14	Number of vehicles now occupying link
15	Code (0,1) if ramp link in K = 13 is (right hand, left hand)
16	Radius of curvature, feet/100

K	Description
17	Unused
18	Number of vehicles discharged from link since beginning of simulation or beginning of subinterval, depending on reporting option, i.e., cumulative or subinterval specific
19	Total moving time (at desired free-flow speed) of all vehicles traversing link, tenths-of-a-second
20	Total delay time, tenths-of-a-second
21	Total delay time, halves-of-an-hour
22	Total moving time, halves-of-an-hour
23	Right hand lane of pair separated by barrier
24	Number of downstream link servicing through traffic (or downstream node of exit link $\geq$ 700)
25	Unused
26	Number of vehicles occupying link at end of last subinterval
27	Right hand lane of pair separated by barrier
28	Location within DTCTR array that the first detector data for this link is stored
29	Number of vehicle closest to upstream node in lane 1
30	Same as 29 for lane 2
31	Same as 29 for lane 3
32	Same as 29 for lane 4
33	Same as 29 for lane 5
34	Same as 29 for first auxiliary lane

K	Description
35	Same as 29 for second auxiliary lane
36	Location within INCID array containing the first incident data for this link
37	Lane identification for lane in downstream link (receiving through traffic) which receives traffic from lane 1 of this link
38	Location on this link at which an early warning sign becomes visible (in percent of link length from upstream node)
39	Node locating off-ramp referred to by early warning sign
40	Pavement code: 1 = dry concrete 2 = wet concrete 3 = dry asphalt 4 = wet asphalt
41	Superelevation (%)
42	Lane change counter

LNKR (K,L) Array INTEGER*2

K	Contents	Description
1	XXXXY	XXXX = Length of ramp, feet Y = Number of lanes
2	WZYXX	XX = Mean free-flow speed, fps Y = Grade code Z = Code (0,1) if grade is (positive, negative) W = Code (0,1) if this link is an (on,off) ramp
3	XXXY	XXX = Identifying number of link servicing first movement of vehicles leaving this link (surface link number for off-ramps and freeway link number for on-ramps) Y = Code (0,1) if first movement is (left, through)
4	XXXY	XXX = Identifying number of surface link servicing second movement of vehicles leaving this link (only applies for off-ramps) Y = Code (1,2) if second movement is (through, right)
5	XXXYY	XXX = Number of vehicles now occupying link YY = Percentage of total volume on ramp link, L, which makes the second movement (Y in LNKR (4,L))
6	XXXXX	XXXXX = Number of vehicles discharged from link since beginning of simulation or beginning of subinterval depending on reporting option; i.e., cumulative or subinterval specific
7	XXXXX	XXXXX = Total moving time (at desired free-flow speed) of all vehicles traversing link, tenths-of-a-second

K	Contents	Description
8	XXXXX	XXXXX = Total delay time, tenths-of-a-second
9	XXYY	XX = Total moving time, halves-of-an-hour YY = Total delay time, halves-of-an-hour
10	XXYYY	XX = Number of vehicles occupying link at end of previous subinterval YYY = Location within the DTCTR array that the first detector data for this link is stored
11	XXXXY	XXXX = Time in queue, halves-of-an-hour Y = "Type" of intersection at downstream node; used as index of TLNK array
12	XXXX	XXXX = Number of vehicle closest to up-stream node in lane 1
13	XXXX	XXXX = Number of vehicle closest to up-stream node in lane 2
14	XXYZZ	XX = Speed of previously discharged queued vehicles, fps Y = Signal code facing link ZZ = Mean queue discharge headway, tenths-of-a-second (applies only to off-ramps)
15	ZXXY	Y = Lane identification for lane in down-stream link (receiving through traffic) which receives traffic from lane 1 of this link XX = Radius of curvature (ft/100) Z = Pavement code: 1 - dry concrete; 2 - wet concrete; 3 - dry asphalt; 4 - wet asphalt
16	YYXX	XX = Superelevation (%) YY = Start-up lost time for first queued vehicle (applies to off-ramps only), tenths-of-a-second

K	Contents	Description
17	XXXX	XXXX = Time in queue, tenths-of-a-second
18	XXXX	XXXX = Number of cycle failures

LNKS (K,L) Array INTEGER*2

K	Contents	Description
1	XXXXY	XXXX = Link length, feet
		Y = Number of lanes, not including turn pockets
2	VWXYZ	Z = Channelization code for lane 1
		Y = Channelization code for lane 2
		X = Channelization code for lane 3
		W = Channelization code for lane 4
		V = Channelization code for lane 5
3	XXYYY	XX = Start-up lost time for first queued vehicle, tenths-of-a-second
		YYY = Location within DTCTR array in which the first detector data for this link is stored
4	XXYYY	XX = Capacity of left-turn pocket
		YYY = Number of vehicles occupying link
5	XXXX	XXXX = Number of vehicles discharged from this link since start of simulation or beginning of subinterval depending on reporting option; i.e., cumulative or subinterval specific
6	XXXX	XXXX = Total moving time (at desired free-flow speed) of all vehicles traversing link, tenths-of-a-second
7	XXXX	XXXX = Total delay time, tenths-of-a-second
8	XYYYZ	X = Code (0,1) if link receiving left-turn traffic (is not, is) a ramp
		YYY = Link number which receives left-turn traffic (or, downstream node of exit $\geq$ 800)
		Z = Current signal code facing link

K	Contents	Description
9	XYYYZ	X and YYY same as for K=8 but for through traffic Z = "Type" of intersection at downstream node
10	±XYYYZ	X and YYY same as for K=8 but for right-turn traffic Z = Grade code. This word is (+,-) if grade is (positive, negative)
11	XXXYY	XXX = Percent of traffic turning left YY = Mean queue discharge, tenths-of-a second
12	XXXYY	XXX = Percent of traffic proceeding through YY = Mean free-flow speed, fps
13	XXXYY	XXX = Percent of traffic turning right YY = Total moving time, halves-of-an hour
14	XXXX	XXXX = Time in queue, tenths-of-a-second
15	XXXXY	XXXX = Time in queue, halves-of-an hour Y = Capacity of right-turn pocket
16	XXXXY	XXXX = Identification of last vehicle in lane 1 (nearest the upstream node) Y = Original queue position occupied by vehicle in lane 1 now ready to discharge
17	XXXXY	Same as for K=16, but for lane 2
18	XXXXY	Same as for K=16, but for lane 3
19	XXXXY	Same as for K=16, but for lane 4
20	XXXXY	Same as for K=16, but for lane 5
21	YYXXX	XXX = Number of opposing link, if any, which carries on-coming traffic impeding left turners

K	Contents	Description
		YY = Total delay time, halves-of-an-hour
22	XXXYY	XXX = Number of vehicles occupying link at conclusion of previous subinterval YY = Number of signal cycle failures

VF (K,M) Array   INTEGER*2

K	Description
1	Origin node (last 2 digits)
2	Destination node (last 2 digits)
3	Process code (0,1) if vehicle (has not, has) been processed this time step
4	Distance of vehicle from upstream node, feet
5	Code (0,1) if vehicle is (accelerating, decelerating)
6	Current speed, ft/sec
7	Acceleration or deceleration of vehicle during this time step, ft/sec^2
8	Number of vehicle in front of this vehicle in current lane
9	Code (0,1) if this vehicle (M) will (continue on, leave) the freeway at the downstream node
10	Desired lane and lane switch code:

Code	Meaning
0	Preferred lane is not mandatory
1	Preferred lane is mandatory, vehicle must achieve this lane before leaving link
2	Vehicle currently changing lanes to the left (occupies 2 lanes) and preferred lane is not mandatory
3	Vehicle currently changing lanes to the left and preferred lane is mandatory
4	Vehicle currently changing lanes to the right and preferred lane is not mandatory
5	Vehicle currently changing lanes to the right and preferred lane is mandatory

K	Description
11	Number of vehicle behind this vehicle in current lane

K	Description
12	Vehicle type code: 1 = low performance passenger car 2 = high performance passenger car 3 = inter-city bus 4 = heavy single unit truck 5 = trailer truck
13	Driving characteristic of motorist
14	Desired free-flow speed, ft/sec
15	Current lane
16	Preferred lane on this link
17	Current freeway link
18	New lane change code: Code Meaning 0 Vehicle desires lane change to either left or right 1 Vehicle desires change to left 2 Vehicle desires change to right 3 No change desired 4-9 If value is greather than or equal to 4, vehicle is changing lanes. For this case, the value is the time step during lane change process plus 4
19	Code (0,>0) if vehicle formerly in front of this vehicle (is not, is) still in process of a lane change
20	Unused
21	Downstream node at which vehicle will leave freeway (flagged upon passing an early warning sign)
22	Node number at which vehicle will be diverted from freeway

VR (K,M) Array INTEGER*2

K	Contents		Description
1	ZXXYY	XX =	Destination node (last 2 digits)
		YY =	Origin node (last 2 digits)
		Z =	Process code: 0 - if vehicle has not been processed this time step; 1 - if vehicle has been processed this time step; 2 - if vehicle made lane change to left but has not been processed yet
2	XXXXW	XXXX =	Distance of vehicle from upstream node, ft. If vehicle becomes first in queue then XXXX = time remaining till discharge, tenths-of-a-second
		W =	Current lane
3	WXYZZ	W =	Queue code: 0 - if vehicle is not in queue; 1 - if vehicle is in queue; 2 - if vehicle queued because of cycle failure
		X =	Turn code: 0 - if vehicle will turn left; 1 - if vehicle is travelling thru; 2 - if vehicle will turn right
		Y =	Acceleration or deceleration of vehicle during this time step, ft/sec^2
		ZZ =	Current speed, ft/sec
4	XXXX	XXXX =	Number of vehicle in front of this vehicle
5	XXXX	XXXX =	Number of vehicle in back of this vehicle
6	WYXZZ	W =	Code (0,1) if vehicle is (accelerating, decelerating)
		Y =	Vehicle type code: 1 - low performance passenger car; 2 - high performance passenger car; 3 - intercity bus; 4 - heavy single unit truck; 5 - trailer truck

K	Contents	Description
		X = Driving characteristic of motorist
		ZZ = Desired free-flow speed, fps
7	XXX	XXX = Node number at which vehicle was diverted from freeway
8	XXX	XXX = Current ramp link number

VS (K,M) Array INTEGER*2

K	Content	Description
1	ZXXYY	XX = Destination node (last 2 digits) YY = Origin node (last 2 digits) Z = Process code: 0 - if vehicle has not been processed this time step; 1 - if vehicle has been processed this time step; 2 - if vehicle made lane change to left but has not been processed
2	XXXXW	XXXX = Distance of vehicle from upstream node, feet. If vehicle becomes first in queue, then XXXX = time remaining till discharge, tenths-of-a-second W = Current lane
3	WXYZZ	W = Queue code: 0 - if vehicle is not in queue; 1 - if vehicle is in queue; 2 - if vehicle queued because of cycle failure X = Turn code: 0 - if vehicle will turn left; 1 - if vehicle is travelling thru; 2 - if vehicle will turn right Y = Acceleration or deceleration of vehicle during this time step, ft/sec^2 ZZ = Current speed, ft/sec
4	XXXX	XXXX = Number of vehicle in front of this vehicle
5	XXXX	XXXX = Number of vehicle in back of this vehicle
6	WYXZZ	W = Code (0,1) if vehicle is (accelerating, decelerating) Y = Vehicle type code: 1 - low performance passenger car; 2 - high performance passenger car; 3 - intercity bus; 4 - heavy single unit truck; 5 - trailer truck

K	Contents	Description
		X = Driving characteristic of motorist ZZ = Desired free-flow speed, fps
7	XXX	XXX = Node number at which vehicle was diverted from freeway
8	XXX	XXX = Current surface link number

COMMON /A2/

NTOTL	Scalar defining maximum allowable combined number of all link types
IVFEET(L)	Number of feet travelled on link, L, where L = Freeway link number, or ramp link number + NLFR, or surface link number + NLFR + NLRA
ENDNDS (L,K)	INTEGER*2 and INTEGER Array L = Link number, defined as for IVFEET K = 1 for element specifying node at upstream end of link, L K = 2 for elements specifying node at downstream end of link, L

COMMON /A3/

NTOTN — Scalar defining maximum allowable number of nodes (also largest node number)

SIGI (N,K) = YXXX   INTEGER*2 and INTEGER

N = Node number

K = Approach to Node N (Max. 4)

Y = Code, as follows

Code	Definition
0	Freeway link approach
1	Ramp link approach
2	Surface link approach

XXX = Freeway, ramp or surface link number of this approach

COMMON /A4/

NDET — Scalar defining maximum allowable number of detectors

IDET — Current number of detectors specified

DTCTR(N,K); INTEGER and INTEGER*2 array describing detector, N, as follows:

K	Contents	Description
1	XXXX	XXXX = Location of upstream end of detector in feet from upstream node, or acquisition point for doppler radar
2	WXYZZ	W = Code (0,1) if this detector (was not, was) generated to output plot parameters X = Code as follows: X Detector Type 0 Doppler radar 1 Short loop 3 Downstream loop of coupled pair 4 Upstream loop of coupled pair Y = Lane code ZZ = Effective loop length, feet
3 For plot output detectors only	XXXXX	XXXXX = Sum of speeds of vehicles crossing detector in plot output time interval (for plot output detectors)
Short loop	XYYYY	X = Code (0,1) if detector (is not, is) currently occupied YYYY = Length of time that status *before* current status (X) prevailed, tenths-of-a-second
Doppler radar	XXX	XXX = Speed of last acquired vehicle, ft/sec
4 For plot output detectors only	XXXX	XXXX = Number of vehicles crossing detector in plot output time interval (for plot output detectors)

K	Contents	Description
For doppler or loop detectors	XXXX	XXXX = Vehicle number of vehicle which last entered loop or was acquired by radar
5	XXX	XXX = Pointer defining number of next detector for this link (≡ 0, if no more detectors)
6 Short loop	XXXX	XXXX = Length of time that current status has prevailed, tenths-of-a-second
doppler radar	XXXX	XXXX = Time of actuation, tenths-of-a-second
7	XX	XX = Station number for this detector (≤ 50)

COMMON /A5/

NINCI	Scalar defining maximum allowable number of incidents
INCID(N,K)	INTEGER*2 array describing incident, N, as follows:

K	Contents	Description
1	VWXYZ	Z = Incident code for lane 1 Y = Incident code for lane 2 X = Incident code for lane 3 W = Incident code for lane 4 V = Incident code for lane 5 Incident Codes: Code — Effect 0 — Normal speed 1 — Traffic capacity reduced at point of incident by "rubber neck" factor 2 — Blockage at point of incident
2	VWXYZ	Z = Incident code for first left auxiliary lane Y = Incident code for second left auxiliary lane X = Incident code for first right auxiliary lane W = Incident code for second right auxiliary lane V = (0,1) if this (is not, is) the final incident for this link
3	XXXX	XXXX = Longitudinal location of upstream end of incident from upstream node, feet
4	XXXX	XXXX = Length of roadway affected by incident, feet
5	XXXX	XXXX = Time of onset, in seconds from the start of simulation
6	XXXX	XXXX = Duration of incident, seconds

K	Contents	Description
7	WWXYY	WW = Pointer indicating location of next incident for this link X = Code (0,1) if incident (is not, is) over YY = Percent reduction in capacity at point of incident for "rubberneck" lanes

COMMON /A6/

MNODE — Scalar denoting maximum node number active in current network

IANOD — Scalar denoting maximum allowable number of actuated nodes

MANOD — Scalar denoting maximum number of actuated nodes in current network

SIG(NTOTN,4) is a full word INTEGER array containing the signal codes facing each of the four possible approaches to a particular node (i $\leq$ NTOTN) for all signal intervals as follows:

SIG(N,I) = UVWXYZ (for fixed time or sign control)

where N = Node number
I = Approach number

and Z = control code, interval 1, facing approach I
Y = control code, interval 2, facing approach I
X = control code, interval 3, facing approach I
W = control code, interval 4, facing approach I
V = control code, interval 5, facing approach I
U = control code, interval 6, facing approach I

For actuated control SIG(N,1) = -XYY

where X = Actuated control algorithm I.D. code
YY = Actuated node number ($\leq$ IANOD)

NPHS (NTOTN,6) is half word (INTEGER*2 for IBM) INTEGER array containing the six possible interval durations for all nodes in the network. Each duration is expressed in seconds.

SIGT (NTOTN) is a half word (INTEGER*2 for IBM) INTEGER array containing the current active interval for each node and the time remaining in that interval.

SIGT(N) = XXXY

where XXX = Remaining time in interval, tenths-of-a-second
Y = Current active interval at node N

IACPAR (24,IANOD) is a half word (INTEGER*2 for IBM) array containing the 24 possible parameters associated with each actuated control node.

COMMON /A7/

NS Scalar denoting current number of entry links

SNODE(J,K) - full word INTEGER array. This array identifies the status of freeway and surface entry links "feeding" the network. Maximum number of entry links accommodated by model is NTOTN. Each entry link, J, is described by a vector of elements. Note that the index, J, assigned internally to the entry links by the model, is not the identifying link number, L.

K	Contents	Description
1	YXXX	Y = (0,1) for (freeway, surface) entry J XXX = Link number (by type)
2	XXXX	XXXX = Emission headway on this entry, hundredths-of-a-second for surface entries, thousandths-of-a-second for freeway entries
3	WWXXYYZZ	WW = % of Vehicle Type 2 XX = % of Vehicle Type 3 YY = % of Vehicle Type 4 ZZ = % of Vehicle Type 5
4	XXXX	XXXX = Time remaining till next emission, hundredths-of-a-second for surface entries, thousandths-of-a-second for freeway entries
5	WWXXYYZZ	WW = % vehicles assigned to lane 2 XX = % vehicles assigned to lane 3 YY = % vehicles assigned to lane 4 ZZ = % vehicles assigned to lane 5

COMMON /A8/

The following arrays of COMMON/A8/ should be declared INTEGER: SPLPCT, CLEN, VFH, TLNK, FOLK, CSTDCL, VFHF. For IBM version of program, the following should be declared INTEGER*2: IPACK, TLNK, LIMSPD, MAXAC, CSTDCL, LNMNSP, ITPCT.

JMPG(I) - probability of a lead left-turn vehicle jumping at the beginning of the green phase across I incoming lanes, expressed as percentage. JMPG(I)=38 for I equals 1 through 5. These values are as defined for the UTCS-1 simulation model.

ILT - Speed to which vehicle unimpeded by traffic must slow to negotiate a left turn, applied deterministically.
ILT = 22 ft/sec.

IRT - Same as ILT for right turn
IRT = 13 ft/sec

IALAG - Acceptable lag in target lane so that vehicle can switch lanes, applied deterministically.
IALAG = 31 sec/10

JERK(I) - Maximum JERK for vehicle type I, ft/sec^3.
JERK(I) = 70, I = 1,5

SPLPCT(I) - A vehicle facing a spillback condition in its receiving link at the time it is about to discharge into it must "decide" whether to discharge or wait until spillback dissipates. This decision affects only through vehicles. Left-turners always join spillback (other conditions permitting) while right-turners are physically blocked by spillback. Probability of vehicle joining spillback comprised of I vehicles is:

I	1	2	3	4
SPLPCT	100	81	69	40

CLEN(I) - Car length of vehicle type I, ft., which includes a 3-foot spacing buffer

I	1	2	3	4	5
Car Length	20	20	43	26	53

LSLAG(I) - Vehicle at stop-line facing STOP sign cannot discharge until acceptable gap is available in cross street traffic. Decile distribution of acceptable gaps for near-side (or one-way cross street traffic) is stored in the LSLAG array (sec/10).

I	1	2	3	4	5	6	7	8	9	10
Acceptable gaps	56	50	46	42	39	37	34	30	26	20

ITGAP(I) - An additive factor must be applied for gaps in far-side cross street traffic to account for time required for discharging vehicle to reach far side. ITGAP contains this time, in sec/10, that elapses for vehicle to cross I lanes at acceleration of 8 ft/sec^2.

I	1	2	3	4	5	6	7	8	9	10
Additional time	12	21	26	31	35	39	42	46	49	51

IAMBR(I) - Response of drivers to onset of amber signal is expressed in terms of acceptable deceleration. Applies only to lead moving vehicle in lane with no queue at instant the signal turns amber. The deceleration required for vehicle to stop is readily calculated knowing current position and speed. Using driver characteristic code a decile statistical distribution, IAMBR(I), is entered, to determine whether the acceptable deceleration extracted from distribution exceeds the required value. If so, vehicle will stop; otherwise it will continue through intersection. Values, in ft/sec. are:

I	1	2	3	4	5	6	7	8	9	10
Acceptable deceleration	4	4	5	6	7	9	12	15	18	21

IGAP(I) - A decile distribution of acceptable gaps in oncoming traffic facing left-turning vehicles is stored in IGAP. Values in sec/10 are:

I	1	2	3	4	5	6	7	8	9	10
Acceptable gaps	78	66	60	54	48	45	42	39	36	27

MINAC(I) - Maximum deceleration for vehicle type I, ft/sec^2.

I	1	2	3	4	5
Maximum deceleration	21	21	21	21	16

VFH(I) - As each vehicle enters a link, it is assigned a free-flow speed. This is obtained by multiplying a percentage by the free-flow speed specified for that link. This percentage is obtained from a decile distribution; the index, I, is the driver characteristic code

I	1	2	3	4	5	6	7	8	9	10
Percentage values:	75	81	91	94	97	100	107	111	117	127

VFHF(I) - Percentage of mean speed by driver type I on freeway links

I	1	2	3	4	5	6	7	8	9	10
percentage	82	91	94	97	99	101	103	106	109	118

FOLK(I) - sensitivity factor for driver type I which determines desired car following distance

I	1	2	3	4	5	6	7	8	9	10
sensitivity factor	19	18	17	16	15	14	13	12	11	10

LSTTIM - Start-up lost time for first queued vehicle on off-ramps (tenths of a sec.)

LSTTIM = 22

LIMSPD(I,J) - limiting speeds by vehicle type (I) and grade index (J) (fps)

Vehicle type	Grade J	0° 1	2° 2	4° 3	6° 4
1		200	200	200	200
2		200	200	200	200
3		98	84	70	57
4		98	84	70	57
5		84	50	32	23

MAXAC(I,J,K) - Vehicle acceleration profiles by vehicle type (I), grade (J), and speed (K). Note: vehicle types 1 and 2 are freeway accelerations for autos; types 6 and 7 represent non-freeway accelerations for types 1 and 2 respectively (fpss)

For values, see Tables 45 - 48.

Table 45

Calibration Acceleration in MAXAC Array

Integer Acceleration Rates in Ft/Sec^2

			Speed (ft/sec)				
			K=1	2	3	4	5
J	Grade	Low Performance Passenger Car	0→20	20→40	40→60	60→80	80
1	-4%	Freeway, I=1	8	8	8	5	3
		Non-Freeway, I=6	5	4	3	3	3
2	0%	Freeway, I=1	6	6	6	3	2
		Non-Freeway, I=6	4	3	2	2	2
3	2%	Freeway, I=1	6	6	5	2	1
		Non-Freeway, I=6	4	3	2	1	1
4	4%	Freeway, I=1	5	5	3	1	1
		Non-Freeway, I=6	3	3	1	1	1
5	6%	Freeway, I=1	5	5	3	1	1
		Non-Freeway, I=6	3	3	1	1	1

Table 46

Calibration Acceleration in MAXAC Array

Integer Acceleration Rates in $Ft./Sec.^2$

J	Grade	High Performance Passenger Car	Speed (ft/sec)				
			K=1	2	3	4	5
			0→20	20→40	40→60	60→80	Above 80
1	-4%	Freeway, I = 2	15	14	14	8	5
		Non-Freeway, I = 7	9	6	5	5	5
2	0%	Freeway, I = 2	11	11	10	5	3
		Non-Freeway, I = 7	7	5	3	3	3
3	2%	Freeway, I = 2	10	10	8	4	2
		Non-Freeway, I = 7	7	5	3	2	2
4	4%	Freeway, I = 2	9	9	5	2	1
		Non-Freeway, I = 7	6	5	2	1	1
5	6%	Freeway, I = 2	9	9	4	2	1
		Non-Freeway, I = 7	6	4	1	1	1

Table 47

Calibration Acceleration in MAXAC Array

Integer Acceleration Rates in Ft/Sec^2

For Buses and Heavy Single-Unit Trucks (I=3,4)

J	Grade	Speed (ft/sec)				
		K=1	2	3	4	5
		0→20	20→40	40→60	60→80	Above 80
1	-4%	3	2	2	2	1
2	0%	3	2	1	1	1
3	2%	2	1	1	1	1
4	4%	1	1	1	1	0
5	6%	1	1	1	0	0

Table 48

Calibration Acceleration in MAXAC Array

Integer Acceleration Rates in Ft/Sec^2

For Trailer Trucks (I=5)

J	Grade	Speed (ft/sec)				
		K=1	2	3	4	5
		0→20	20→40	40→60	60→80	Above 80
1	-4%	2	2	2	1	1
2	0%	1	1	1	1	1
3	2%	1	1	1	0	0
4	4%	1	1	0	0	0
5	6%	1	0	0	0	0

CSTDCL(I,J) - freeway coasting deceleration by vehicle type (I) and speed (J) in fps.

I	Speed Range (fps) 0-40 J=1	40-60 J=2	>60 J=3
1	1	2	3
2	1	2	3
3	1	1	1
4	1	1	1
5	1	1	1

LNMNSP(I,J) - lane mean speed (percentage) by total number of lanes (I+1) and lane number (J).

Total # of Lanes	I	Lane Number, J 1	2	3	4	5
2	1	94	106	-	-	-
3	2	93	101	106	-	-
4	3	93	97	105	105	-
5	4	94	95	101	106	104

ITPCT(I,J) - percentage of commercial vehicles assigned to each lane, by total number of lanes (I+1) and lane number (J).

Total # of Lanes	I	Lane Number, J				
		1	2	3	4	5
2	1	75	25	-	-	-
3	2	50	50	0	-	-
4	3	38	37	25	0	-
5	4	30	30	30	10	0

TLNK(I,K) - As each queued vehicle moves up to stop-line, it is assigned a delay until discharge, in sec/10, reflecting queue discharge headways. This headway is obtained by multiplying mean queue discharge headway specified for link by percentage, obtained from decile distribution which applies to that "type" of link. Distribution is indexed by vehicle driver characteristic code. Data gathered on a test site indicates a single "type" of link for the purpose of defining a queue discharge headway distribution. This distribution is stored in the TLNK(I,K) array where I denotes intersection "type", and K, the decile index (I = 1,2 considered):

K	1	2	3	4	5	6	7	8	9	10
Percentage Values	170	120	120	110	100	100	90	70	70	50

The headway so obtained must be modified if vehicle was 2nd or 3rd in queue when signal turned green. The following values must be added to headway:

2nd vehicle: TLNK(I,25) = 5 sec/10
3rd vehicle: TLNK(I,26) = 2 sec/10

If vehicle was not an auto, further modification is made: value must be multiplied by percentage to reflect different operating characteristics of other type vehicles.

Type	2	TLNK(I,21) = 100
	3	TLNK(I,22) = 160
	4	TLNK(I,23) = 160
	5	TLNK(I,24) = 160

First vehicle in queue when light turns green suffers a (start-up) lost time. If this lost time is specified on the link card, it is applied deterministically. Otherwise, lost time, in sec/10, is extracted from decile distribution using the vehicle driver characteristic; distribution referenced is defined by type, I, of link. Distribution is also stored in TLNK(I,K) array.

K	11	12	13	14	15	16	17	18	19	20
type 1	56	36	32	30	26	22	20	16	12	6
type 2	68	40	30	24	20	16	12	8	6	0

IPACK(I) - Array to be used when unpacking or packing one vector of LNKF, LNKR, or LNKS array.

COMMON /A9/

CHEK78(12), INTEGER. This array contains flag digits indicating the presence and type (freeway and non-freeway) of external (entry, exit) nodes. Each digit represents one possible node number.

<u>Digit i value</u>

0	No node exists in either the 700 or 800 series
1	There exists an external node = 700 + (i-1)
2	There exists an external node = 800 + (i-1)
3	Error: Both the 800 + (i-1) and 700+ (i-1) exist

The digits are stored, 9 to each word, as follows:

CHEK78(1) = IHGFEDCBA

where

A is the value for i = 1
B is the value for i = 2
etc.

CHEK78(2) contains the values for digit i=10 through i=18, etc.

For example: If CHEK78(1) = 1202, the subject network would contain the external nodes 703, 802 and 800.

COMMON /A10/

The following arrays of COMMON /A10/ should be declared INTEGER: VPROC, THRUV, RTRNV, VCONT. For IBM version of program, all arrays in COMMON /A10/ should be declared INTEGER*2.

VPROC(L)	Number of vehicles discharged from link L through end of prior subinterval where: L = Freeway link number, or ramp link number + NLFR, or surface link number + NLFR + NLRA
MNUVR(L,K)	Total number of vehicles for link L assigned to the various turning movements from beginning of simulation to present as follows: K = (1,2,3) for (left, through, right) movements
LTRNV(L), THRUV(L), RTRNV(L)	These arrays contain the number of vehicles assigned to the various turn movements through the end of the prior subinterval for link L.
VCONT(L)	Number of vehicles occupying link L at end of prior subinterval

COMMON /A11/

ISTATN		Current number of entries in LSTATN
NSTATN		Maximum number of entries in LSTATN
LSTATN(I)	=	ZZZXXXX ZZZ = Link number (by type) XXXX = Distance from upstream node of station for recording mean and frequency distribution output data (feet)

COMMON /A12/

IFCOEF(I)	Friction coefficient for pavement code I, $1 \leq I \leq 9$ (percentage). Embedded value is 50 for all pavement codes. These values are synthetic and do not represent real friction coefficients due to the lack of data during the program development. The user should input appropriate values.
IGRVAL(I)	Grade value for grade code I, $1 \leq I \leq 5$ (percentage) (must be in ascending order). The embedded values are:

I	1	2	3	4	5
Grade Value	-4	0	2	4	6

COMMON /ACT0/

MACR	Maximum number of intersection actuated traffic control nodes
NNCR	Actual number of intersection actuated traffic control nodes in network
ISTDET	Distance of assumed detector from stop line. Embedded value is 60 feet.

COMMON/ACT1/

NAFZ(N,J,8) Contains eight data elements describing phase J at actuated controller, N. The eight elements are defined as follows:

Data Element	Contents	Description	
1	XYYY	X = Phase actuation code YYY = Yield point if phase J is non-actuated or force-off point if phase J is actuated, seconds	
2	XXX	XXX = End of yield interval, sec.	Non-actuated phase
	or YXX	XX = Minimum initial interval, sec Y = Initial interval code	Actuated phase
3	YYXX	YY = Initial interval data XX = Initial actuations data	Actuated phase
4	YYXX	YY = Maximum passage time, tenths-of-a-second XX = Minimum gap, tenths-of-a-second	
5	YYXX	YY = Amount of gap reduced every second, tenths-of-a-second XX = Maximum extension, i.e., maximum green service interval, seconds	Actuated phases

Data Element	Contents	Description
	or XXX	XXX = Time elapsed since onset of phase to the onset of the amber interval } Non-actuated phases
6	ZYXX	XX = Maximum green, i.e., initial + added + green service intervals Y = Amber duration, seconds Z = Red clearance duration, seconds
7	ZYX	Z = Recall switch code (0,1) if (off, on) Y = Red revert time, seconds X = Memory switch code (0,1) if passage, presence) detectors
8	YX	Y = Inhibit maximum termination code (0,1) if green service interval (is, is not) terminated when maximum time is attained X = Overlap code: 0 if no other phases overlap with phase J 1 if phase J overlaps with phase J-1 2 if phase J is overlapped by phase J+1 3 if phase J overlaps phase J-1 and is overlapped by phase J+1

COMMON/ACT2/

NAAFZ(N,I,J) — Identifies the signal currently active on ring I of the actuated controller, N. For J=1 the (parent) phase is the only phase active. For J=2 a non-null entry identifies the phase that overlaps the indicated parent phase.

COMMON/ACT3/

NATMR(N,5,J) — Contains five data elements that define the condition of the active phase on ring J at actuated controller, N. The five elements are defined as follows:

Data Element	Contents	Description
1	XXYYY	XX = Red revert time, seconds YYY = Time gap since last actuation for passage detectors, tenths-of-a-second. For presence detectors code (1,3) if a vehicle (is, is not) present.
2	XXXYY	XXX = Timer for current active interval (intervals with status codes 1 to 5), sec. YY = Timer for maximum service green, sec. } Actuated phases

Data Elements	Contents	Description
		XXX = Time elapsed since onset of phase, sec., for non-coordinated phase only. Not used for coordinated phase. YY = 0 for non-actuated phases (Non-Actuated phases)
3	XXXYY	XXX = Cycle time for coordinated controllers, sec. This timer cycles over the range [1,c] and is used to test YIELD intervals and force-off points YY = Current value of passage time for active phase if passage detector, tenths-of-a-second. If presence detector YY=2.
4	XX	Contains two timers that can never be concurrent; hence, they can occupy same storage XX = Calculated value of added initial time or XX = Timer for extension period, i.e., green service interval, sec.
5	XX	Timer for the "slave" phase that overlaps the prior phase, sec.

COMMON/ACT4/

NADET(N,I,J) Identifies the location and lane of detector, I, which services phase J of actuated controller, N, as follows:

I	Contents	Description
1	XXXY	Location of the detector that furnishes actuations (and calls) for the initial interval of the inactive phase, J, where: XXX = link number Y = lane number
2	XXXY	As for I=1, for another detector
.	.	.
.	.	.
.	.	.
8	XXXY	As for I=1, for another detector
9	XXXY	Location of the detector that furnishes actuations to test against the current value of passage time, for the service green interval of the active phase, J, where: XXX = link number Y = lane number
10	XXXY	As for I=9, for another detector
.	.	.
.	.	.
.	.	.
16	XXXY	As for I=9, for another detector

COMMON/ACT5/

NADTM(N,I,J) Contains the most recent actuation time of the passage detector (which services the actuated controller, N) identified in NADET (N,I+8,J) if phase J is active. If phase J is inactive the latest actuation time of the detector is stored.

COMMON/ACT6/

NACNT(N,I,J) Contains the current value of vehicle actuations recorded by detector, I (defined by NADET(N,I,J) of COMMON/ACT4/), servicing phase, J, of actuated controller, N, since the time that phase, J, became inactive. If I identifies a presence detector, this element is zero if no vehicles are present, 1 otherwise. When phase, J, becomes active, these elements are reset.

COMMON/ACT7/

NALNK(N,L) Contains the link number corresponding to approach L being serviced by actuated controller, N, where the number stored is link number+NLFR+NLRA.

COMMON/ACT8/

NACDS(N) Contains identifying characteristics of actuated controller, N, as follows:
= WXYZ where
W = Code (0,1,2) if controller is (single ring, dual ring and single entry, dual ring and dual entry)
X = Code (0,1) if controller (is not, is) coordinated
Y = Code (0,1) if controller will (dwell in current active phase, terminate current active phase and rest-in-red) in response to an absence of demand
Z = Code (0,1) if detector switching feature is (inactive, active)

COMMON/ACT9/

NACYC(N) Contains the fixed cycle length of coordinated actuated controller, N. If controller is not coordinated, this element is zero.

COMMON/ACT10/

NACT(K) Contains the actuated controller number corresponding to node K.

COMMON/ACT11/

NADEC(N,I,J) Contains a code that pertains to the phase identified in NAAFZ(N,I,J) of COMMON/ACT2/ as follows:

0 if phase will continue to be active

1 if phase will terminate under following conditions:

  a) if a single-ring controller
  b) if a dual ring and following phase
  c) if a dual ring, this phase is at barrier and phase on other ring is also at barrier and also terminating

2 if phase will terminate at end of this time step

COMMON/ACT12/

NASTAT(N) — Contains in a packed word the status code of all phases at actuated controller, N.
= STUVWXYZ where
Z = Status code for Phase 1
Y = Status code for Phase 2
X = Status code for Phase 3
W = Status code for Phase 4
V = Status code for Phase 5
U = Status code for Phase 6
T = Status code for Phase 7
S = Status code for Phase 8

Status Code	Description
0	Phase does not exist
1	Phase is active in initial interval
2	Phase is active in added initial interval
3	Phase is active in service green interval
4	Phase is active in amber interval
5	Phase is active in red clearance interval
6	Phase is active in red revert interval
7	Phase is inactive (red)

COMMON/ACT15/

NEWDET(N,I,J) Contains in a packed word information on the last actuation of detector I, servicing controller, N, during phase J as follows:
= XXXXXYY where
XXXXX = Time of last actuation, tenths-of-a-second
YY = speed of vehicle at last actuation, fps.

COMMON/ACT16/

MTERM(J) Code (0,1) if phase J is to be (unchanged, terminated at) this time step.

COMMON/ACT18/

ND Node number at which actuated controller is located. NACT(ND) defines the controller number.

COMMON /ACT20/

SIGA(N,4) INTEGER array containing the signal codes facing each of the four approaches to actuated node N for all signal intervals as follows:

SIGA(N,I) = RSTUVWXYZ for approach I to actuated node N where,

Z = Control code, interval 1, facing approach I
Y = Control code, interval 2, facing approach I
X = Control code, interval 3, facing approach I
W = Control code, interval 4, facing approach I
V = Control code, interval 5, facing approach I
U = Control code, interval 6, facing approach I
T = Control code, interval 7, facing approach I
S = Control code, interval 8, facing approach I
R = Control code, interval 9, facing approach I

COMMON/CONTRL/

Variable RNSEED must be declared INTEGER

I99LAS	Code = (0,1) if the current 99 card request (is not, is) the last request to be processed.
IRSCT	Identification of the current simulation subinterval.
NEXCAL	Code denoting which Module is currently being processed or, when returning from a Module to the INTRAS supervisor, it denotes the next Module to be called. NEXCAL is defined initially by the supervisor after reviewing the Type 99 Card codes. Subsequently, it is reset at the exit from each Module.

Value	Module
0	INTRAS
1	PORGIS
2	LIS
3	MIFSIM
4	FUEL
5	INCES
6	POSPRO
7	INPLOT
8	SAM
9	Case Over (Read new 99 card)

LASUBF	Code = (0,1) if the current simulation subinterval (is not, is) the last one.
IFN	Identifies the file being treated by the input/output subroutine DRWS.
IOP	Identifies the operation to be performed by the DRWS subroutine, as follows:

Value	Operation
1	Read
2	Write
3	Rewind
4	Backspace
5	End file

IFORM	Identifies the format to be applied in the current DRWS subroutine read/write operation.
ILEN	Defines the length of the current DRWS subroutine read/write operation. ILEN is set = -1 in DRWS if an end-of-file is encountered when reading
ISCOT	Time at end of last time step stored in UPSIG for use by CAL4, tenths-of-a-second.
INLOC	Identifies the current positioning of the Case Data Tape. The value of INLOC is equal to the sequence number of the following case.
IPL	Code = (0,1) if the CALCOMP plot tape (has not, has) been utilized during the current run.
ICTYPE	Case Type as specified in column 2 of previous Type 99 card.
ICSIN	Sequence number of required case Data Deck to be retrieved from Case Data Tape.
ICSRN	Run Identification of required Case Data Deck to be retrieved from Case Data Tape.
IINOT	Incident Data Disposition flag from column 11 of Type 99 card.
IPTOT	INPLOT Data Disposition flag from column 12 of Type 99 card.
ISTOR	Case Data Disposition flag from column 14 of Type 99 card.
ISTAT	Statistical Data Disposition flag from column 15 of Type 99 card.
IININ	Run identification of Incident Detection data set to be retrieved from Incident Data Tape.
IINCON	Code = (0,1) if the Run Identifications for those cases on the Incident Data Tape (are not, are) to be printed.
IPT	Code = (0,1,2) if the current case (is neither an INPLOT or SAM run, is an INPLOT run, is a SAM run).

ICARD	Type of last data card read.
ICDCT(4)	Array of counters containing the number of cards of types 00 → 03 in the current case data deck. This information is used to insure that cards containing alphabetic data are not read under numeric formats.
IBUF(30)	Buffer array used for initial storage of card data.
MINSTS	User specified freeway simulation time step, in tenths-of-a-second.
MAXSTS	Frequency at which lane change logic will be implemented, in time steps.
RNSEED	Random number seed.
IDRUN	Run identification number
MXINIT	Maximum Length of Initialization, seconds.
IFILGO	Flag (0,1) if fill time (is not, is) to continue to maximum length even if initialization is reached.
IGO	Flag (0,1) if simulation (is not, is) to proceed if equilibrium is not achieved during fill time.
ISTFLG	Flag (0,1) if statistics are to be (cumulative, subinterval specific).
NTRN	Flag (0,1) if (turn movement, traffic assignment) routing mode is in effect.
ITPOP	Interval for output of trajectory plot information, sec.
ITPLNK(24)	Link ID Table for output of trajectory plot data. YXXX: Y = (0,1,2) for (freeway, ramp, surface) link; XXX = link number.
ICPOP	Interval for output of contour plot information, min.
ICPLNK(24)	Link ID table for output of contour plot data, YXXX.
ICPSP	Spacing of detectors generated to output contour plot information, feet.

IIDOP	Polling frequency for digital detectors (number/sec). Default is 10.
IIDLNK(24)	Link ID Table for output of incident data, YXXX.
NDT	Length of subinterval, sec.
IDMN	Interval for printout of (cumulative, sub-interval specific) statistics, sec.
NPRNT	Interval for printout of intermediate output, sec.
ISECI	Time of first intermediate output from start of subinterval, sec.
IDSEC	Time span over which intermediate output is to be produced, sec.
IODFLG	Flag (0,1) if O-D volumes (are not, are) to be printed at end of subinterval.
ILSUB	Flag from type 60 card = (0,1) if this (is, is not) the last subinterval.
IIDMOD	Detector mode flag (0,1) for (digital, analog) detectors.

COMMON/CRASH/

The following arrays and variables of COMMON/CRASH/ must be declared INTEGER*2 for the IBM version of the program: KON, MAXCEL, LENTHV, IPPT, IMMOE, INCALG, MOEALG, KPOINT.

KON(I) XY
X = code (0,1) if detector I (is not, is) being used for incident detection
Y = detector state:
0 if detector I has not been activated yet
1 if last actuation was a deactivation
2 if last actuation was an activation

LASTON(I) Last activation time for detector I

LASTOF(I) Last deactivation time for detector I

IOCC(I) Occupancy for detector I (unscaled)

IOCC2(I) Occupancy for detector I (scaled down to point calculation)

INPOS(I) YYYYYYXXX
YYYYYY = Location of sensor (a group of detectors used for incident detection) I in feet from upstream end of link
XXX = node downstream of sensor I

INCODE(K,J) Contains incident codes corresponding to the segment of roadway between sections K and K+1 used by the J^{th} algorithm to be applied. See INCALG for the algorithm number corresponding to the J^{th} algorithm. Incident code is
1 if no incident
2 for onset of incident
3 for end of incident
4 for continuing incident

LOCATE(K)	YXXXZZZ ZZZ = Station number corresponding to sensor position K XXX = First detector at sensor position K Y = Code (0,1) if this (is not, is) the last sensor position LOCATE contains a sequence of sensors used for incident detection and MOE estimation. The end of a series is denoted with an entry where XXX=0.
OCCS(K,5)	Contains history of occupancies at sensor position K. OCCS(K,1) contains current occupancy. OCCS(K,2) through OCCS(K,5) contain occupancies for the previous four time periods.
OCCOLD(K,J)	For the J^{th} incident detection algorithm applied at sensor position K, OCCOLD(K,J) contains the occupancy that existed immediately before an incident occurred.
MAXCEL	Number of occupancy updating intervals in an incident evaluation period.
INTVAL	The incident evaluation period in milli-seconds.
IUPDAT	The occupancy updating interval in milli-seconds.
KALL	A running count of the number of calls to incident detection routines.
IZERO	Time, in milliseconds, at the beginning of the current occupancy updating interval.
IFIN	Time, in milliseconds, at the end of the current occupancy updating interval.
LENTHV	Average vehicle length, in feet, used for incident detection.

IPPT	Code (0,1) if point processing (is not, is) desired.
IMMOE	Code (0,1) if MOE estimation (is not, is) desired.
INCALG(J)	The J^{th} element contains the number of the incident detection algorithm to be applied.
MOEALG(J)	The J^{th} element contains the number of the MOE estimation algorithm to be applied.
EPARAM(18,J)	For the J^{th} incident detection algorithm applied up to 18 input parameters are stored in EPARAM (1,J) through EPARAM(18,J).
MPARAM(3,J)	For the J^{th} MOE algorithm applied up to three input parameters are stored in MPARAM(1,J) through MPARAM(3,J).
NSECTL(K)	Distance, in feet, between section K and section K+1.
MAXSTA	Maximum number of stations.
LNKSTA(L)	YXXXZZZ For detector station L: Y = link type XXX = link number where station is located ZZZ = sensor position corresponding to detector station L. (Used as an index in the LOCATE array.)
NUMSTN	Number of detector stations.
KPOINT(I)	Given detector I belonging to a detector station, KPOINT(I) defines the next detector at that station. If KPOINT(I) is zero, detector I is the last detector at that station.

COMMON/DBLEXP/

Contains the double exponential smoothing arrays required for incident detection algorithm 3.

SMTH1(K)	Single exponentially smoothed time series for station K.
SMTH2(K)	Double exponentially smoothed time series for station K.
YERR(K)	Series of estimation errors for station K.
ABSD(K)	Mean absolute deviation time series for station K.
SSQ(K,I)	Contains the sum of the error terms when I=1 and the sum of the error terms squared when I=2 for station K.

COMMON / ERTRAN/

IER	Index defining the specific error condition prevailing when the EROT subroutine is called.
NPAR	Index which transmits the number of parameters which must be printed out for the error condition specified by IER.
IEPAR(10)	Array in which error message parameters are stored prior to call to EROT subroutine.
IERCT	Error counter.

COMMON / IHEAD/

IHEAD(40)	Array containing title from card type 00 and network name from card type 01.

COMMON /FORINC/

ICALL	Code (0,1) if INCDAT (has not, has) been called for this case
NUMBER	A running count of the number of records in the output buffer to be transferred to INCDAT utility tape
IINC	Code (0,1) of this (is not, is) the last call to INCDAT. This last call is with no new data but simply to output whatever remains in the output buffer at the end of the last subinterval.

The following six variables are zero except after a call to DETECT when a non-doppler detector has been activated but not de-activated by a vehicle which has reached the end of the link.

LNUDE	Activated detector number
LLEND	Detector length
LLDET	Detector position on link
LLNLEN	Link length
VELOLD	Vehicle velocity at link boundary.
ACCOLD	Vehicle acceleration at link boundary.

ISTART	Time at start of freeway vehicle movement (when calling COLECT) in tenths-of-a-second. ISTART is approximately equal to ITIMEF but may exceed it.
ISTEP	Duration of freeway vehicle movement in tenths-of-a-second ISTEP $\leq$ IDTF

LENVH	Vehicle length, feet (includes 3 foot spacing buffer which must be subtracted when determining vehicle detector actuations)
IPOS1	Position of vehicle at start of movement. Distance from upstream end of link, in feet
ISPD1	Velocity of vehicle at start of movement in feet/sec.
LINK1	Freeway link on which vehicle resides at start of movement
LANE1	Freeway lane on LINK1 in which vehicle resides at start of movement
IPOS2 ISPD2 LINK2 LANE2	These four parameters are analagous to IPOS1, ISPD1, LINK1 and LANE1. They define the vehicle state at the end of the movement. ISPOS2 is measured from the upstream end of LINK2 and so, if LINK1 ≠ LINK2, <u>the length of LINK1 must be added to IPOS2 for distance comparisons</u>. In the event the vehicle has left <u>the freeway during the interval ISTEP, LINK2 will be set equal to -1</u>.
NCHNG	Number of Freeway time steps (of length IDTF) required to change lanes
ICUR	Original lane of lane-changing vehicle. If vehicle not changing, ICUR = 0.
LINEON	Code (0,1) if online incident detection (is not, is) being performed
INCTIM	Time for next call to SINCES
IVNUM	Vehicle Identification number

COMMON / FPAR/

INCH	Amount of time to complete a lane-change maneuver in tenths-of-a-second. Embedded value is 30.
NCH	Index indicating the end of lane change to process (number of freeway time steps to complete a lane change +4)
INRAMP	Code for on-ramps
IRF	Index (2,3) for roadway type (ramp, freeway)
IORD	Position of link being processed in IFRANK array of COMMON /RANK/
MINHDY	Minimum separation in tenths-of-a-second for generation of freeway vehicles. Embedded value is 5.
IP	Lane change probability in percent. Embedded value is 5.
MNAC	Minimum non-emergency freeway acceleration, tenths-of-a-foot per second. Embedded value is -80.
ISENS	Percent of drivers desiring to yield right of way. Embedded value is 40%
LAGA	Lag to accelerate in tenths-of-a-second. Embedded value is 3.
LAGB	Lag to decelerate in tenths-of-a-second. Embedded value is 2.
KET	Time interval for current vehicle movement
LAG	Effective lag for current vehicle reaction time

COMMON/FREDAT/

Used to store the lane specific speed and headway data gathered at freeway data stations during the course of simulation. All arrays of COMMON/FREDAT/ must be declared INTEGER.

FRHDWY(I,J,K) Contains the count of vehicles passing freeway data station I in lane J (J=6 refers to first auxiliary lane, J=7 refers to second auxiliary lane) as follows:

FRHDWY(I,J,1) = WWXXYYZZ

where ZZ = count of vehicles for which headway $\leq$ .6 sec.

YY = count of vehicles for which .6 sec. < headway $\leq$ 1.0 sec.

XX = count of vehicles for which 1.0 sec. < headway $\leq$ 1.4 sec.

WW = count of vehicles for which 1.4 sec. < headway $\leq$ 1.8 sec.

FRHDWY(I,J,2) = Same as FRHDWY(I,J,1) for cells from 1.8 sec. to 3.4 sec.

FRHDWY(I,J,3) = Same as FRHDWY(I,J,1) for cells from 3.4 sec. to 5.0 sec.

FRHDWY(I,J,4) = Same as FRHDWY(I,J,1) for cells from 5.0 sec. to 6.6 sec.

FRHDWY(I,J,5) = same as FRHDWY(I,J,1) for cells from 6.6 sec. to 8.2 sec.

FRSPED(I,J,K) Contains the count of vehicles passing freeway data station I in lane J (where J is defined as for FRHDWY) as follows:

FRSPED(I,J,1) = WWXXYYZZ

where ZZ = count of vehicles for which speed $\leq$ 4 mph

YY = count of vehicles for which 4 mph < speed $\leq$ 8 mph

XX = count of vehicles for which 8 mph < speed $\leq$ 12 mph

WW = count of vehicles for which 12 mph < speed $\leq$ 16 mph

FRSPED(I,J,2) = same as FRSPED(I,J,1) for
cells from 16 mph to 32 mph
FRSPED(I,J,3) = same as FRSPED(I,J,1) for
cells from 32 mph to 48 mph
FRSPED(I,J,4) = same as FRSPED(I,J,1) for
cells from 48 mph to 64 mph
FRSPED(I,J,5) = same as FRSPED(I,J,1) for
cells from 64 mph to 80 mph.

FRCONT(I,J) XXXXYYYY for freeway data station I in lane J (where J is defined as for FRHDWY)
where XXXX = count of all vehicles considered for speed distributions
YYYY = count of all vehicles considered for headway distributions
Counts stop being incremented when some cell total reaches 99.

FRFLAG(I,J) XYZZZZ for freeway data station I in lane J (where J is defined as for FRHDWY)
where X = code (0,1) if some headway cell (has not, has) reached 99
Y = same as X but for speed
ZZZZ = vehicle number which last passed freeway data station I in lane J at time specified by FRTIM(I,J)

FRTIM(I,J) Contains the time that last vehicle passed freeway data station I in lane J (where J is defined as for FRHDWY).

COMMON /IMBDIN/

IMBDIN	Code (0,1) if changes to imbedded data (were not, were) input

COMMON /INCDMP/

NUMOUT — Number of actuations stored in ICIN

ICIN(I,N) — ICIN is the output accumulating buffer for the INCES Data Tape. It stores information on actuations at all detectors.

If I=1, then ICIN (1,N) = YYYXXX

where

XXX = detector number actuated
YYY = the speed (hundredths-of-mph) for doppler detectors or flag (1,0) if actuation was (an activation, a deactivation) for loop detectors.

If I=2, then ICIN (2,n) contains the time of actuation (milliseconds)

<u>COMMON /IPLTN/</u>

IPLTN	Length of last record written to Plot Data Tape

<u>COMMON /LASDCH/</u>

LADISH (NTOTL,3)	Each element LADISH (I,J) contains the vehicle identification number for a recently discharged vehicle from link I where: I = freeway link number or ramp link number + NLFR, or surface link number + NLFR + NLRA The three most recently discharged vehicles (J=1,2,3) are recorded for use in locating downstream interference for subsequent vehicles attempting to discharge from link I.

COMMON /LENVI/

	The following arrays must be declared INTEGER*2 for the IBM version: LLNR, LCCR, LMTR, LDTR, LLTR, LFFR, LTTR, LMHR, LRTR, LSTR, LSHR, LUVR, LDHR, LFTR, LPRR, LPOR, LSPR, LACR, LVLR, LLOR, LLNA, LLLA, LLPA, LSTA, LRPA, LEXA, LPRA, LPOA, LSPA, LACA, LTCA
LINK	Number of link whose environment is stored in arrays of this COMMON block
LANE	Number of lane in LINK
IOOF	Code (0,1) indicating whether LINK, if it is a ramp, is (on,off)
IRALL	LANE identification of lane in downstream link which receives traffic from lane 1 of this link (1 for surface links)
IDITR	Number of feet travelled on link number LINK
JDNODE	ENDNDS(L,2) entry for link number LINK
LTSURF	Code (0,1,2) indicating lane type (thru, right pocket, left pocket) of lane number LANE
LADICH(K)	Vehicle numbers of last K vehicles discharged from this link. The number of the last vehicle discharged is placed in position K, the next to last vehicle in position K-1 and so on.
LLOR(I)	Order of lanes right to left of I possible lanes. The maximum value of I is 5
LLNR(J)	Number of thru lanes for receiving link J. J equals (1,2,3) indicates (left, thru, right) direction

LCCR(J,I)	Lane channelization codes for lane I of link J where J is defined as above
LMTR(J)	Move time (tenths-of-a-second) for receiving link J
LDTR(J)	Delay time (tenths-of-a-second) for receiving link J
LLTR(J)	Percent of traffic on receiving link J turning left
LFFR(J)	Free flow speed for receiving link J
LTTR(J)	Percent of traffic on receiving link J going through
LMHR(J)	Move time (halves-of-an-hour) for receiving link J
LRTR(J)	Percent of traffic on receiving link J turning right
LSTR(J)	Time in queue (tenths-of-a-second) on receiving link J
LSHR(J)	Time in queue (halves-of-an-hour) on each receiving link J
LUVR(J,I)	Upstream vehicle in lane I on receiving link J
LDHR(J)	Delay time (halves-of-an-hour) on receiving link J
LFTR(J)	IVFEET(L) entry for receiving link J
LPRR(J,I)	Code (0,1) for lane I of receiving link J if it (has not, has) been processed yet
LPOR(J,I) LSPR(J,I) LACR(J,I) LVLR(J,I)	Position, speed, acceleration and length of upstream vehicle in lane I of receiving link J

LLNA(J)	Number of thru lanes for approach link J
LLLA(J)	Length of approach link J
LLPA(J)	Capacity of left turn pocket on approach link J
LSCA(J)	Signal code facing approach link J
LRPA(J)	Capacity of right turn pocket on approach link J
LEXA(J)	Code (0,1) if approach link J (does not, does) exist
LPRA(J)	Code (0,1) for approach link J if it (has not, has) been processed yet
LPOA(J,I) LSPA(J,I) LACA(J,I)	Position, speed and acceleration of down-stream vehicle in lane I of approach link J
LTCA(J,I)	Turn code of farthest downstream vehicle in lane I of approach link J

COMMON/NFILTS/

NDSCHG	A count, maintained during fill time, of vehicles exiting the network. It is used to determine if equilibrium has been reached.
NDSCHO	The value of NCSCHG stored at end of previous equilibrium evaluation interval.
NENTRO	Number of vehicles which had entered the network at the end of previous equilibrium evaluation interval.
NLASEQ	Code (0,1) if equilibrium (was not, was) achieved during last equilibrium evaluation interval.

COMMON/NIDTSV/

NIDTSV	Used to store number of time steps in first subinterval during fill time.

COMMON /ONVEH/

NORG	Number of last item in tables IORG, IRV and IREN
IORG(50)	(INTEGER*2) XXXY XXX = link number Y = lane number of a freeway link that vehicle on an onramp will enter
IRV(50)	(INTEGER*2) Ramp vehicle number of vehicle entering freeway link
IREN(50)	(INTEGER*2) Time of vehicle arrival in tenths-of-a-second since last freeway time step

COMMON /P1/

NAMES(L,6)	Name of absolute link number, L (see COMMON /A2/ description for definition of L). Names may be 24 characters in length and are stored in 6 words with 4 characters/word.

COMMON /RANK/

NFENT	Number of freeway entries
IFRANK (NTOTL)	(INTEGER*2) Contains the sequence of freeway links in downstream to upstream order ending with the entry link number if there is one. IFRANK may contain more than one sequence.

COMMON /S1/

MESSER	Flag set $\neq 0$ upon entry to FINDL to disable error message

COMMON /S2/

IDTF	Current Freeway time step, tenths of a second
IDTS	Current surface time step, tenths of a second
ITIME	Current time since start of simulation, tenths of a second
ITIMEF	Current time (at end of last freeway time step) for freeway link, tenths of a second
IDT	Surface time step number in current subinterval (equal to index of control loop)
IFDT	Number of tenths of a second which have elapsed since the end of the last freeway time step
NIDT	Number of surface time steps in current subinterval (used as upper limit of control loop)
IPSL	Length of previous subinterval (or fill time), seconds
IEXCS	Time in this subinterval in excess of NIDT surface time steps, tenths of a second
MCYCL	Maximum cycle length in network or 30 sec. is no fixed time control, tenths of a second
IMCYCL	Counter to determine if one MCYCL period has elapsed, tenths of a second.
IREVP	Inactive

ICOINT	Counter to determine if one contour plot output interval has elapsed, tenths of a second
ICYCPO	Counter to determine if standard output period has elapsed since last report was generated
INTSTO	Counter to determine if intermediate detail output report period has elapsed
ITRINT	Counter to determine if one trajectory plot output interval has elapsed, tenths of a second
IHOURS IMINS ISECNS	Real clock time at beginning of simulation

COMMON /S3/

ISSEQ	Indicator of purpose of call to either HICON or LOCON
ISRET	Indicator of reason for return to SIFT from HICON or LOCON

COMMON /SIZE/

NLFR	Current maximum number of freeway links for which space has been allotted in NLV array
NLRA NLSU NVFR NVRA NVSU	As for NLFR for ramp links, surface streets, freeway vehicles, ramp vehicles, surface link vehicles
NLFO	Offset of first freeway link from start of NLV array. That is, the scalar which must be added to each freeway link number to locate the link data in the NLV array
NLRO NLSO NVFO NVRO NVSO	As for NLFO for the other link and vehicle arrays
MXLFR	Current number of freeway links
MXLRA	Current number of ramp links
MXLSU	Current number of surface links
MXVFR	Current number of freeway vehicles
MXVRA	Current number of ramp vehicles
MXVSU	Current number of surface link vehicles

IS(5)	(INTEGER*2) Array of constants, $IS(I) = 10^{I-1}$
IWDPAK(5)	(INTEGER*2) Array of descriptors which identify the word and low order digit locations for all the parameters of the various link and vehicle arrays. Each element is formatted as XXY where, XX indicates the word/half-word containing the I^{th} parameter, and Y indicates the digit of that word/halfword which locates the low order digit of the I^{th} parameter

IWDIND(I) (INTEGER*2) Each element of this array indicates the element of the IWDPAK array which corresponds to the first parameter of one of the link or vehicle arrays as follows:

I	Array	IWDIND(I)
1	LNKF	1
2	LNKR	43
3	LNKS	76
4	VF	123
5	VR	145
6	VS	162
7	*	179

*This is a dummy to facilitate locating the end of the VS parameters

NWDS(I) (INTEGER*2) Each element of this array contains the number of words/halfwords in one of the link or vehicle arrays, as follows:

I	Array	NWDS(I)
1	LNKF	42
2	LNKR	18
3	LNKS	22
4	VF	22
5	VR	8
6	VS	8

COMMON /SRFLAG/

LTFLAG	1, if link being processed is a ramp link 2, if link being processed is a surface link

COMMON /VBUF/

COMMON /VBUF/ is used mainly during the simulation process for storing vehicle parameters. However, it may be used at other times as a temporary storage area for various types of information.

NF(I)	(INTEGER*2) Contains unpacked freeway vehicle parameters
NRL(J)	(INTEGER*2) Contains unpacked ramp vehicle parameters
NRA(J)	(INTEGER*2) Contains unpacked ramp vehicle parameters
NFL(I)	(INTEGER*2) Contains unpacked freeway vehicle parameters
NFA(I)	(INTEGER*2) Contains unpacked freeway vehicle parameters

COMMON /VEER/

```
LNEND(3,9) = XXXXYYYY

             XXXX = Location of upstream end of
                    incident or lane end, relative
                    to upstream end of subject link

             YYYY = Location of downstream end of
                    incident or lane end. Equals 9999
                    if lane never opens up again (e.g.,
                    end of accel. auxiliary lane)
```

Up to 3 incidents are allowed for each of 9 possible lanes.

```
LNRUB(9) = XXYYZZ

           XX = Rubbernecking factor for incident
                1 of lane

           YY = Rubbernecking factor for incident
                2 of lane

           ZZ = Rubbernecking factor for incident
                3 of lane
```

COMMON /VENVI/

JVIDL	Lead vehicle of subject vehicle
JVIDLL	Lead vehicle in lane to left of subject vehicle
JVIDRL	Lead vehicle in lane to right of subject vehicle
JVDHL	Distance of JVIDL from upstream node or headway of JVIDL if JVIDL is first vehicle in queue
JVDHLL	Same as JVDHL for vehicle JVIDLL.
JVDHRL	Same as JVDHL for vehicle JVIDRL.
JVSPL	Speed of JVIDL (ft/sec)
JVSPLL	Speed of JVIDLL (ft/sec)
JVSPRL	Speed of JVIDRL (ft/sec)
JVQL	Queue code (0,1) if JVIDL (is not, is) in queue or 2 to indicate cycle failure
JVQLL	Same as JVQL for vehicle JVIDLL
JVQRL	Same as JVQL for vehicle JVIDRL
JVLEL	Number of vehicle in front of JVIDL
JVLELL	Number of vehicle in front of JVIDLL
JVLERL	Number of vehicle in front of JVIDRL
JVFOL	Number of vehicle in back of JVIDL
JVFOLL	Number of vehicle in back of JVIDLL
JVFORL	Number of vehicle in back of JVIDRL
JVVCL	Driver code of vehicle JVIDL
JVVCLL	Driver code of vehicle JVIDLL
JVVCRL	Driver code of vehicle JVIDRL

JVACL	Code (-1, 0, +1) if JVIDL is (decelerating, travelling at constant speed, accelerating)
JVACLL	Same as JVACL for vehicle JVIDLL
JVACRL	Same as JVACL for vehicle JVIDRL
JVIDF	Number of vehicle behind subject vehicle
JVIDLF	Number of vehicle behind subject vehicle in left lane
JVIDRF	Number of vehicle behind subject vehicle in right lane
JVPRF	Process code (0,1) if JVIDF (has not, has) been processed this time step or 2 if a change was made to the left but the vehicle was not processed
JVPRLF	Same as JVPRF for vehicle JVIDLF
JVPRRF	Same as JVPRF for vehicle JVIDRF
JVDHF	Distance of JVIDF from upstream node or headway of JVIDF, if JVIDF is first vehicle in queue
JVDHLF	Same as JVDHF for vehicle JVIDLF
JVDHRF	Same as JVDHF for vehicle JVIDRF
JVSPF	Speed of JVIDF (ft/sec)
JVSPLF	Speed of JVIDLF (ft/sec)
JVSPRF	Speed of JVIDRF (ft/sec)
JVACF	Acceleration or deceleration of JVIDF
JVACLF	Acceleration or deceleration of JVIDLF
JVACRF	Acceleration or deceleration of JVIDRF
JVQF	Code (0,1) if JVIDF (is not, is) in queue or 2 to indicate cycle failure
JVQLF	Same as JVQF for vehicle JVIDLF
JVQRF	Same as JVQF for vehicle JVIDRF

JVLEF	Number of leader of JVIDF
JVLELF	Number of leader of JVIDLF
JVLERF	Number of leader of JVIDRF
JVLC	Link code (0,1) to indicate change (original link, new link)
JVFSP	Final speed of subject vehicle
JVFS	Final position of subject vehicle
JVFLN	Final lane of subject vehicle
JVFLK	Final link of subject vehicle
JVFLTY	Code (0,1) of final link type (surface, ramp) of subject vehicle
JVFLE	Final leader of subject vehicle
JVFFO	Final follower of subject vehicle
JVFAC	Final acceleration/deceleration (+/-) of subject vehicle
JVILT	Time on initial link
JVFLT	Time on final link
IDRL	Lane to right of subject vehicles lane
IDLL	Lane to left of subject vehicles lane
LCFV	Code (0,1) if a change (has not, has) been made this time step
LCDF	Lane change desire code (0,1,2,3) if (no desire, right, left, either)
LCPF	Lane change possibility code (0,1,2) if change is (not possible, right, left)
NEVE	Next vehicle to be processed (original follower)

LEDIS	Leader discharge flag set to 0 at start of lane processing. If a vehicle discharges, LEDIS is set equal to time of discharge after start of time step (tenths-of-a-second).
JSIGP	Code = 0, if signal permissive 1, if yield prohibitive 2, if prohibitive
JSIGC	Code = 1, if signal just became permissive 0, otherwise
JSIGS	Code = 1, if stop or yield or vehicle performing right turn on red 0, otherwise
JVIDM	Vehicle identification number of subject vehicle

COMMON /VPOINT/

IFPT	Freeway vehicle array pointer
IRPT	Ramp vehicle array pointer
ISPT	Surface vehicle array pointer

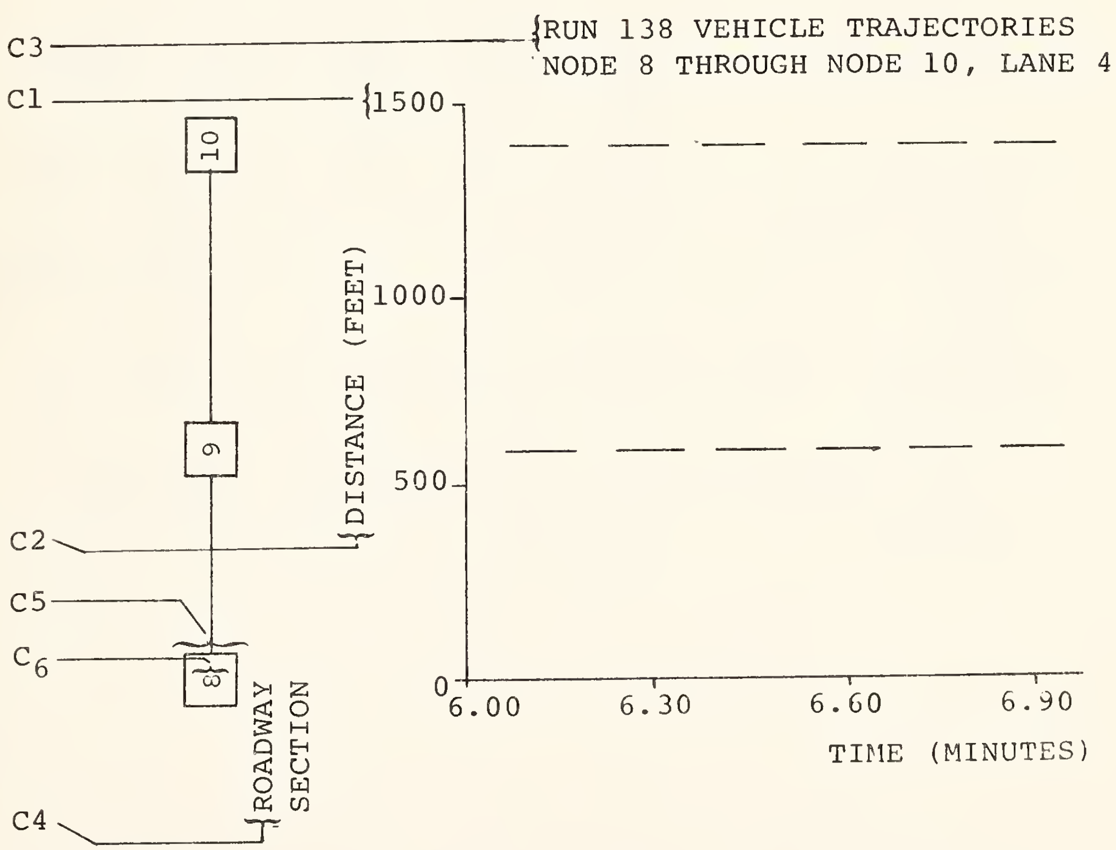
Pointer denotes position to begin searching for an empty vehicle slot.

INPLOT Module COMMON Block Definitions

COMMON /CHT/

C1 Height of numbers labelling hashmarks (in.)
C2 Height of time and distance labels (in.)
C3 Height of top heading (in.)
C4 Height of roadway section label (in.)
C5 Height of roadway section box (in.)
C6 Height of node number within box (in.)

The elements of COMMON /CHT/ are labelled in the following plot design:



COMMON /CNTR/

FS INTEGER, Distance from upstream node of link of station being processed (feet)

SGAP INTEGER, Distance between stations on link (feet)

SMAX INTEGER, Number of stations on link

CTR(I,J) Contour default value J for MOE index I

MOE	Name	Default Values
1	Spot Speed (mph)	10., 14., 18., 22., 26., 30., 34., 38., 42., 46., 50., 54., 58., 62.
2	Volume veh/hr/lane	900., 1000., 1100., 1200., 1300., 1400., 1500., 1600., 1700., 1800., 1900., 2000., 2100., 2200., 2300.
3	Density veh/lane-mi.	35., 40., 45., 50., 55., 60., 65., 70., 75., 80., 85., 90., 95., 100.
4	Delay min/mi	0., .25, .50, .75, 1.0, 1.25, 1.50, 1.75, 2.0, 2.25, 2.5, 2.75, 3.0, 3.25
5	Headway sec/veh	.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0
6	Travel time min/veh	1.0, 1.25, 1.5, 1.75, 2.0, 2.25, 2.5, 2.75, 3.0, 3.25, 3.5, 3.75, 4.0, 4.25

COMMON /CRD/

IREQ	Plot request code: 1 - Index of plot data tape contents 2 - Contour plot 3 - Trajectory plot 4 - MOE contour changes
RUNID	INTEGER, Case id of case to be plotted
LANE	Lane number (trajectory plots)
IMOE	MOE index (contour plots)
DISPX	Displacement of x-axis origin from page origin (inches)
DISPY	Same as DISPX for y-axis (inches)
XLIM	x-axis length (inches)
YLIM	y-axis length (inches)
XPAGE	Page width (parallel to x-axis) (inches)
YPAGE	Page height (parallel to y-axis) (inches)
XORG	x-coordinate of origin (lower left corner of page) (inches)
YORG	y-coordinate of origin (inches)

COMMON /IPERR/

IPERR	Code (0,1) if there (was not, was) an error of any type at any point in producing a plot. If an error occurs, the plot is aborted and the next plot request is processed.

COMMON /LANET/

LANET	Lane number in furthest upstream link while generating trajectory plots for a group of consecutive links

COMMON /PLT/

IDVEH(I)	Buffer containing i.d.'s of vehicle trajectory points in VPOS array for I vehicles
VPOS(I,J)	INTEGER array containing position of vehicle I at time step J (for trajectory plots)
LNKID(100,2)	LNKID(I,1) = XXXYYYZW where XXX = upstream node YYY = downstream node Z = lane number W = receiving lane for link I LNKID(I,2) initially contains length of link-lane I, which is converted in AXPLOT routine to distance from beginning of path to link I
NDLIST(20)	Contains indices of entries in LNKID array which form plot path requested by user
LKCNT	Number of entries in NDLIST array
LEN	Total length of path to be plotted (feet)
N	Total number links of contour data on tape
M	Total number link-lanes of trajectory data on tape
UNODE	INTEGER, upstream node of path to be plotted
DNODE	INTEGER, downstream node of path to be plotted

NDS(20)	Contains upstream and downstream node numbers which form path to be plotted (used only when trajectory plot for all lanes is requested)

COMMON /T1/

MAXV	Maximum number of vehicles allowed in plot buffer or maximum number of stations in MOE array
MAXT	Maximum number of time points allowed in VPOS or MOE array

COMMON /TMDAT/

TSCALE	Time scale for plots (minutes/inch)
DSCALE	Distance scale (feet/inch)
DELT1	INTEGER, time step for contour data (minutes)
DELT2	INTEGER, time step for trajectory data (seconds)
TIME1 TIME2	INTEGER, start and stop times for plot data (min.) from beginning of simulation
NXT1	Time at which next contour data point will occur on tape (sec.)
NXT2	Same as NXT1, for trajectory data
ISTEP	Current time step number (index for VPOS and MOE arrays)
START	INTEGER, time from beginning of plot of first data point in VPOS or MOE array (sec.)
KPLOT	Total number of plots

FUEL Module COMMON Block Definitions

COMMON /BFUEL/

KHCEM(I,J,K)	INTEGER*2 array. Hydrocarbon emissions for acceleration of I-13 fpss and speed of J-1 fps for vehicle type K (milligrams/sec.)
KCOEM(I,J,K)	INTEGER*2 array. Same as KHCEM but for carbon monoxide emissions
KNOEM(I,J,K)	INTEGER*2 array. Same as KHCEM but for oxides of nitrogen emissions
KFLCN(I,J,K)	INTEGER*2 array. Fuel consumption, as above (hundred-thousandths of a gallon/sec.)

COMMON /CFUEL/

JFUEL	Code	
	0	FUEL module is to be run with simulation
	1	FUEL module is to be run using data previously written on tape 23, no simulation
	2	Simulation only, no FUEL module
MFUEL	Code (0,1) if exogenous data cards (are not, are) to be read in	
NU23	Code (0,1) if tape 23 (is, is not) to be written during this simulation	
IPTAB	Code (0,1) if FUEL data tables (are not, are) to be printed out (tables are always printed out if MFUEL = 1)	
NFLG	Code (0,1) if this (is, is not) the first call to FUEL	

COMMON /NRGY/

JVACCP	Number of entries in JVACC buffer
JVACC(J,I)	FUEL vehicle trajectory buffer for vehicle I JVACC(1,I) = YXXX where Y = Link type XXX = Speed, fps JVACC(2,I) = ±WWVUUU where WW = Acceleration or deceleration V = Vehicle type UUU = Link number (+,-) for (acceleration, deceleration)

INCES Module COMMON Block Definitions

COMMON/AMD/

AMDAT(I,J,K) Used as an input-output buffer for MOE estimation. AMDAT(I,J,K) contains information for MOE estimation algorithm I on section K (section K is section between data station K and K+1) where J indicates the information type as follows:

J	Description
1	Volume into section K during current updating interval (veh/hr/lane)
2	Volume out of section K during current updating interval (veh/hr/lane)
3	Space mean speed (mph)
4	Density within section K (veh/lane-mile)

COMMON/INCEST/

INOUT(I,K) Contains incident code for section K (section between data station K and K+1) determined by incident detection algorithm I during the current updating interval.

COMMON/MTOC/

TOCC(K) Average occupancy at sensor position K over time period INTVAL.

COMMON/NUMP/

NPARS(J) — Number of input parameters required in J^{th} incident detection algorithm.

COMMON/PDATA/

ISAMP(K,I) — Contains point processing statistics for station K where I indicates the information type as follows:

I	Description
1	Number of vehicle which crossed station K during the current updating interval
2	Number of vehicle on which there is speed data items for station K during the current updating interval
3	Same as I=2 for headway.

IRAW(K,I) — Contains point processing statistics for station K where I indicates the information type as follows:

I	Description
1	Sum of speeds of all vehicles crossing station K during current updating interval
2	Sum of headways of all vehicles crossing station K during current updating interval.

LASTVU(I) — Contains time that the last vehicle crossed upstream detector I of a coupled pair.

COMMON/TRVTM/

TT(K) — Estimated travel time between station K and K+1 in seconds. Used for MOE estimation.

Statistical Module COMMON Block Definitions

COMMON /SAMP2/

LIN(I,J,K)	Represents link correspondence between network A (K=1) and network B (K=2). J = (1,2) for (freeway, non-freeway) links. The I^{th} link in network B, L = LIN(I,J,2), where L = 1 to number of links, corresponds to the L^{th} link in network A; LINK(L,J,1) = XXXYYY where XXX = upstream node and YYY = downstream node.
NT(M)	If M = 1, NT is network identification number for network A. M = 2, NT is network identification number for network B.
LF	Number of freeway links
LR	Number of ramp links
LS	Number of surface links
N	Number of subintervals simulated
ISKIP	Code (0,1) if non-freeway links (should not be, should be) skipped in analysis
NLSA	Code (0,1) if link by link analysis (should be, should not be) performed for freeway links
NLSA2	Code (0,1) if link by link analysis (should be, should not be) performed for non-freeway links
NFILEA	Number of statistical data input tape
NFILEB	Number of statistical data input tape

COMMON /SAMP3/

DMAT(I,J,K)	Contains the J^{th} MOE corresponding to the I^{th} link in network A in the K^{th} subinterval
DNTA(M,K,N)	Contains the M^{th} MOE averaged over links in subinterval K in netwrok A which consists of (only freeway, all) links for N equals (1,2)
DONETA(I,J)	The I^{th} MOE averaged over subintervals and links in network A which consists of (only freeway, all) links for J = (1,2)
DMBT(I,J,K)	Same as DMAT for network B
DNTB(M,K,N)	Same as DNTA for network B
DONETB(I,J)	Same as DONETA for network B

APPENDIX D

Table 49: Subroutine CALL Cross Reference Chart

INTRAS Module Calling Routine: LRANK	NEXTLN	FINDL	FINDLN	INTRAS	Called Routine
		X		X	EROT
X	X		X	X	DBUG
	X		X		ULNKR
	X				FINDLN
				X	PORGIS
				X	LIS
				X	SIFT
				X	FUEL
				X	INCES
				X	POSPRO
				X	INPLOT
				X	SAM

Table 49: Subroutine CALL Cross Reference Chart (Cont.)

PORGIS Module Calling Routine

INT1	TURNIN	LINOUT	CHKNOD	LINKIN	DETGEN	IMBED	SUROUT	FLOOUT	INACT	SIGOUT	INCIN	SURVIN	PRMSND	CTPSV	CTPSX	CTPFF	PRACT	PRSIG	LPAK	TABCON	PORGIS	Called Routine
X	X		X	X	X	X					X	X	X	X	X	X	X	X	X		X	EROT
	X			X		X					X	X	X	X			X	X		X	X	DRWS
X												X						X				ULNKR
	X							X	X			X	X	X				X				ULNKS
X	X	X		X	X						X	X										UNPAK
X	X			X																		PAK
X					X							X						X				PLNKR
					X							X		X				X				PLNKS
X	X		X								X	X	X					X			X	FINDL
							X															LRANK
																					X	TABCON
				X																		LPAK
																					X	PRSIG
																					X	PRACT
																	X					CTPFF
																	X					CTPSX
																	X					CTPSV
																					X	CLRALL
																					X	PRMSND
																					X	SURVIN
																					X	INCIN
																					X	SIGOUT
										X												INACT
																					X	FLOOUT
																					X	SUROUT
																					X	INCOUT
																					X	IMBED
																					X	IMBEDO
																					X	DETGEN
				X																		MATCH
																					X	LINKIN
				X																		CHKNOD
																					X	LINOUT
																					X	TURNIN
																					X	INT1

Table 49: Subroutine CALL Cross Reference Chart (Cont.)

LIS Module Calling Routine																	
LINT1	LTURNI	LLINOU	LLINKI	LDETGE	LIMBED	LSUROU	LFLOOU	LINACT	LSIGOU	LINCIN	LSURVI	LPRMSN	LCTPSV	LPRACT	LPRSIG	LIS	Called Routine
											X					X	EROT
	X		X		X					X	X	X	X	X	X	X	DRWS
											X						ULNKR
							X	X			X	X	X				ULNKS
X	X	X	X	X						X							UNPAK
X	X		X														PAK
X				X							X				X		PLNKR
				X							X		X		X		PLNKS
X	X		X							X	X	X			X	X	FINDL
																X	NEXTLN
						X											LRANK
			X														LLPAK
																X	LPRSIG
																X	LPRACT
														X			LCTPFF
														X			LCTPSX
														X			LCTPSV
																X	LCLRAL
																X	LPRMSN
																X	LSURVI
																X	LINCIN
																X	LSIGOU
									X								LINACT
																X	LFLOOU
																X	LSUROU
																X	LINCOU
																X	LIMBED
																X	LIMBDO
																X	LDETGE
																X	LLINKI
																X	LLINOU
																X	LTURNI
																X	LINT1

Table 49: Subroutine CALL Cross Reference Chart (cont.)

SIFT Module Calling Routine																																						
TSIG	DETECT	TSTSAT	LANES	LSWCH	GETCD	HDWY	OFFRMP	GOQ	BLOK	CLOSE	SVEH	MOOV	CAL6	CAL5	CAL4	CAL3	CAL2	CAL1	ASIG	ACTFZ	DECACT	TERMFZ	REDSIG	UPACT	PDAFZ	SIGACT	UPSIG	HICON	RANDOM	FINDSV	FINDRV	FINDFV	LASTV	FRSTV	LASTLK	VPAK	SIFT2	Called Routine
		X	X			X	X		X	X	X	X		X	X	X	X	X												X	X	X				X		EROT
		X	X	X	X	X	X	X	X	X	X	X															X	X	X	X	X	X	X	X	X	X	X	DBUG
																																					X	DRWS
												X		X	X												X						X		X			ULNKR
	X											X		X	X	X	X										X						X					ULNKS
		X				X								X												X							X				UVR
	X					X					X			X	X											X							X				UVS
	X						X				X	X																										UNPAK
							X				X	X																										PAK
												X														X											PLNKR
											X	X			X	X	X	X	X								X											PLNKS
							X					X		X												X										X	PVR
											X	X		X												X											PVS
																																			X			FINDLN
															X	X	X																					FINDL
		X								X		X																										NEXTLN
																														X	X	X						VPAK
															X																							FRSTV
																										X											LASTV
												X																										FINDRV
											X	X																										FINDSV
					X			X			X	X		X																								RANDOM
																																					X	HICON
																											X										UPSIG
																										X											SIGACT
																									X												PDAFZ
																									X												PDNAFZ
																									X												UPACT
																							X														GRNSIG
																							X														REDSIG
																							X														TERMFZ
																							X														DECACT
																				X	X																TERM
																					X																ACTFZ
																			X		X	X	X														ASIG
																									X												DETSW
																				X	X	X	X	X													FZCL
																										X											CAL1
																										X											CAL2
																										X											CAL3
																										X											CAL4
																										X											CAL5
																										X											CAL6
																										X											CAL8
																										X											CAL9
																											X										SVEH
												X																										GOQ
												X																										HDWY
			X																																			GETCD
												X																										LSWCH
												X																										LANES
												X																										TSTSAT
																										X											DETECT
												X																										TSIG
												X																										NORM
																											X										CLNUP
																											X										INCDAT
																											X										TPTOUT
																											X										MOEV
												X																										QSTATE
												X																										SEVEN
												X																										REVEN
																											X										FMAIN
							X																															CHOOZ
																																					X	LCCON

Table 49: Subroutine CALL Cross Reference Chart (cont.)

SIFT Module Calling Routine (Continued)

Called Routine	SPOINT	SINC2	SINCES	INTST	CYCP	CPTOUT	FTSC	FILTST	RESET	INIT	LOCON	TYPE	COLECT	ADVANC	CANCEL	ALANE	LCROSS	RISK	CHECK	CHANGE	EMGNCY	CONSOL	FRESET	CHOOZ	ONRMP	FGNRAT	FMOVE	FMAIN	REVEN	GETUNV	SEVEN	RELEN	FILL	SELEN	QSTATE	MOEV	TPTOUT	INCDAT	CLNUP 1	NORM
EROT																												X			X			X				X	X	
DBUG	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
DRWS	X		X			X			X																												X	X	X	
ULNKR				X	X						X								X						X		X						X	X						
ULNKS				X	X			X	X	X	X																						X	X						
UVR				X															X						X		X			X			X						X	
UVS				X																										X			X						X	
UNPAK					X		X										X		X	X					X		X	X			X		X			X		X	X	
PAK																	X			X					X	X	X	X								X				
PLNKR									X	X													X		X							X				X			X	
PLNKS									X	X																						X							X	
PVR																									X				X										X	
PVS																													X										X	
NEXTLN															X		X		X						X	X	X						X							
LRANK											X																													
LASTLK													X						X						X		X													
FRSTV																			X						X		X						X			X				
LASTV															X		X		X						X	X	X				X		X			X				
FINDFV																									X	X														
FINDRV																	X																							
RANDOM												X		X			X		X					X	X	X	X													
MOOV																																				X				
CLOSE																												X												
BLOK																									X		X													
OFFRMP																	X																							
NORM																									X															
INCDAT													X																											
SELEN																																				X				
FILL																																		X						
RELEN																																				X				
GETUNV																															X									
FMOVE																						X				X														
FGNRAT																												X												
ONRMP																						X																		
CHOOZ																		X									X													
FRESET																	X		X																					
CONSOL																												X												
EMGNCY																			X								X													
CHANGE																												X												
CHECK																				X																				
RISK																			X																					
LCROSS																											X													
ALANE																											X													
CANCEL																	X										X													
ADVANC																											X													
COLECT																									X		X													
TYPE																										X														
INIT											X																													
RESET											X																													
FILTST											X																													
FTSC											X																													
CPTOUT											X																													
CYCP											X																													
INTST											X																													
SINCES											X																													
SINC1			X																																					
SINC2			X																																					
SINC3			X																																					
SPOINT			X																																					

Table 49: Subroutine CALL Cross Reference Chart (concl.)

	Calling Routine																									
	SAM Module					INPLOT Module									POSPRO Module	INCES Module										FUEL Module
Called Routine	UTEST	WILCOX	STAT	READCL	SAM	TRAJEC	SPTAL	PATH	PAGE	IOPROC	FILEX	CONTR	AXPLOT	INPLOT	POSPRO	MOUT	MOE3	MOE2	MOE1	PINC	INC2	POUT	POINT	READET	INCES	FUEL
EROT					X	X		X	X			X		X										X	X	X
DBUG										X				X							X		X		X	
DRWS				X	X	X	X			X	X	X		X	X	X				X		X	X	X	X	X
UNPAK				X											X											
PAK																									X	
READET																									X	
POINT																									X	
POUT																									X	
INC1																									X	
INC2																									X	
INC3																									X	
PINC																									X	
MOE1																									X	
MOE2																									X	
MOE3																									X	
TTIME																	X	X	X							
MOUT																									X	
AXPLOT						X						X														
COMPCT						X																				
CONTR														X												
CPLOT												X														
FILEX														X												
IOPROC											X			X												
LEGEND													X													
PAGE													X													
PATH						X	X					X														
SEARCH						X																				
SPTAL														X												
TPLOT						X																				
TRAJEC							X							X												
READCL					X																					
PRINT					X																					
STAT					X																					
TTEST			X																							
CALC			X																							
ANOVA			X																							
WILCOX			X																							
UTEST			X																							
RANK	X	X																								

APPENDIX E

Table 50: INTRAS Link and Vehicle Array Parameter Identification

Parameter No. I Array Specific	Parameter No. J Absolute	IWDPAK(J) IWORD(I)	Description
			LNKF
1	1	11	Number of thru lanes
2	2	21	One-third the length of the freeway link, feet
3	3	31	Code number of auxiliary lane 1
4	4	41	One-third the length of auxiliary lane 1, feet
5	5	51	Code (0,1,2) if aux. lane 1 is (accel., decel.,both)
6	6	61	Code number of auxiliary lane 2
7	7	71	One-third the length of auxiliary lane 2, feet
8	8	81	Code (0,1,2) if aux. lane 2 is (accel., decel.,both)
9	9	91	Mean free-flow speed, fps.
10	10	101	Grade code
11	11	111	Code (0,1) if grade is (positive, negative)
12	12	121	Percent of volume leaving freeway
13	13	131	Ramp number for vehicles leaving freeway
14	14	141	Number of vehicles on link
15	15	151	Code (0,1) if ramp is (right hand, left hand)
16	16	161	Radius of curvature, feet/100
17	17	171	Unused
18	18	181	Number of vehicles discharged
19	19	191	Total moving time, tenths-of-a-second
20	20	201	Total delay time, tenths-of-a-second

Table 50

INTRAS Link and Vehicle array parameter identification (cont.)

			LNKF (cont.)
21	21	211	Total delay time, halves-of-an-hour
22	22	221	Total moving time, halves-of-an-hour
23	23	231	Right hand lane of separated pair
24	24	241	Downstream link for thru movement
25	25	251	Unused
26	26	261	Occupancy at end of last subinterval
27	27	271	Right hand lane of separated pair
28	28	281	Location within DTCTR array for this links first detector
29	29	291	Number of furthest upstream vehicle in lane 1
30	30	301	Upstream vehicle, lane 2
31	31	311	Upstream vehicle, lane 3
32	32	321	Upstream vehicle, lane 4
33	33	331	Upstream vehicle, lane 5
34	34	341	Upstream vehicle, in first auxiliary lane
35	35	351	Upstream vehicle, in second auxiliary lane
36	36	361	Location within INCID array containing the first incident data for this link
37	37	371	Lane identification for lane in downstream link (receiving thru traffic) which receives traffic from lane 1 of this link.
38	38	381	Location on this link at which an early warning sign becomes visible (in percent of link length from upstream node)
39	39	391	Node locating off-ramp refered to by early warning sign

Table 50
INTRAS Link and Vehicle array parameter identification (cont.)

			LNKF (cont.)
40	40	401	Pavement code
41	41	411	Superelevation (%)
42	42	421	Lane change counter
			LNKR
1	43	11	Y = Number of lanes
2	44	12	XXXX = Length of ramp, feet
3	45	21	XX = Mean free-flow speed,fps.
4	46	23	Y = Grade code
5	47	24	Z = Code (0,1) if grade is (positive, negative)
6	48	25	W = Code (0,1) if this is an (on, off) ramp
7	49	31	Y = Code (0,1) if first movement is (left, through)
8	50	32	XXX = Link receiving first movement vehicles
9	51	41	Y = Code (1,2) if second movement is(through, right)
10	52	42	XXX = Link receiving second movement vehicles
11	53	51	YY = Percentage of volume making second movement
12	54	53	XXX = Number of vehicles occupying link
13	55	61	XXXX = Number of vehicles discharged
14	56	71	XXXX = Total moving time, tenths-of-a-second
15	57	81	XXXX = Total delay time, tenths-of-a-second
16	58	91	YY = Total delay time, halves-of-an-hour
17	59	93	XX = Total moving time, halves-of an hour
18	60	101	YYY = Location in DTCTR array of first detector for this link
19	61	104	XX = Content at end of previous subinterval

Table 50

INTRAS Link and Vehicle array parameter identification (cont.)

20	62	111	Y = "Type" of downstream intersection
21	63	112	XXXX = Stopped delay (halves-of-an-hour
22	64	121	XXXX = Furthest upstream vehicle in lane 1
23	65	131	XXXX = Furthest upstream vehicle in lane 2
24	66	141	ZZ = Mean queue discharge headway, tenths-of-a-second (applies only to off-ramps)
25	67	143	Y = Signal code facing link
26	68	144	XX = Speed of previously discharged queued vehicle, fps.
27	69	151	Y = Lane identification for lane in downstream link (receiving through traffic) which receives traffic from lane 1 of this link
28	70	152	XX = Radius of curvature (ft/100)
29	71	154	Z = Pavement code
30	72	161	XX = Superelevation (%)
31	73	163	YY = Start-up lost time (off-ramps only) for first queued vehicle, tenths-of-a-second
32	74	171	XXXX = Stopped delay (tenths-of-a-second)
33	75	181	XXXX = Number of cycle failures
			LNKS
1	76	11	Y = Number of lanes, not including pockets
2	77	12	XXXX = Link length, feet
3	78	21	Z = Lane 1 channelization code
4	79	22	Y = Lane 2 channelization code
5	80	23	X = Lane 3 channelization code
6	81	24	W = Lane 4 channelization code
7	82	25	V = Lane 5 channelization code
8	83	31	YYY = Location in DTCTR array of first detector for this link
9	84	34	XX = First queued vehicle lost time, tenths-of-a-second
10	85	41	YYY = Number of vehicles occupying link

Table 50
INTRAS Link and Vehicle array parameter identification (cont.)

11	86	44	XX =	Capacity of left turn pocket
12	87	51	XXXX =	Number of vehicles discharged
13	88	61	XXXX =	Total moving time, tenths-of-a-second
14	89	71	XXXX =	Total delay time, tenths-of-a-second
15	90	81	Z =	Current signal code facing link
16	91	82	YYY =	Link number receiving left-turn traffic
17	92	85	X =	Code (0,1) if left-turn receiving link (is not, is) a ramp
18	93	91	Z =	"Type" of downstream intersection
19	94	92	YYY } =	as for 16 and 17, for thru traffic
20	95	95	X	
21	96	101	Z =	Grade Code
22	97	102	YYY } =	as for 16 and 17, for right-turn traffic
23	98	105	X	
24	99	106	±	word is (+,-) if grade is (positive, negative)
25	100	111	YY =	Mean queue discharge headway, tenths-of-a-second
26	101	113	XXX =	Percent of traffic turning left
27	102	121	YY =	Mean free-flow speed, fps
28	103	123	XXX =	Percent of traffic proceeding through
29	104	131	YY =	Total moving time, halves-of-an-hour
30	105	133	XXX =	Percent of traffic turning right
31	106	141	XXXX =	Total stopped delay, tenths-of-a-second
32	107	151	Y =	Capacity of right-turn pocket
33	108	152	XXXX =	Stopped delay (halves-of-an-hour)
34	109	161	Y =	Original queue position of vehicle in lane 1 about to discharge
35	110	162	XXXX =	Furthest upstream vehicle, lane 1
36	111	171 }		as for 34 and 35, for lane 2
37	112	172		
38	113	181 }		as for 34 and 35, for lane 3
39	114	182		
40	115	191 }		as for 34 and 35, for lane 4
41	116	192		
42	117	201 }		as for 34 and 35, for lane 5
43	118	202		

Table 50
INTRAS Link and Vehicle array parameter identification (cont.)

44	119	211	XXX = Number of link opposing left turners
45	120	214	YY = Total delay time, halves-of-an-hour
46	121	221	YY = Number of signal cycle failures
47	122	223	XXX = Number of vehicles occupying link at conclusion of previous subinterval
			VF
1	123	11	Origin node (last 2 digits)
2	124	21	Destination node (last 2 digits)
3	125	31	Process code (0,1) if vehicle (has not, has) been processed this time step
4	126	41	Distance of vehicle from up-stream node, feet
5	127	51	Code (0,1) if vehicle is (accelerating, decelerating)
6	128	61	Current speed, fps.
7	129	71	Acceleration or deceleration of vehicle during this time step, fpss
8	130	81	Number of vehicle in front of this vehicle in current lane
9	131	91	Code (0,1) if this vehicle will (continue on, leave) the freeway at the downstream node
10	132	101	"Desired lane and lane switch code"
11	133	111	Number of vehicle behind this vehicle in current lane
12	134	121	Vehicle type code
13	135	131	Driving characteristic of motorist
14	136	141	Desired free-flow speed, fps.
15	137	151	Current lane

Table 50
INTRAS Link and Vehicle array parameter identification (cont.)

16	138	161	Preferred lane on this link
17	139	171	Current freeway link
18	140	181	New lane change code
19	141	191	Code (0,>0) if vehicle formerly in front of this vehicle (is not, is) still in process of lane change
20	142	201	Unused
21	143	211	Node number downstream at which vehicle will exit freeway
22	144	221	Node number at which vehicle was diverted from freeway
			VR
1	145	11	YY = Origin node (last 2 digits)
2	146	13	XX = Destination node (last 2 digits)
3	147	15	Z = Process code (0,1,2) if vehicle (has not, has , changed to left but has not) been processed this time step
4	148	21	W = Current lane
5	149	22	XXXX = Distance of vehicle from upstream node, feet, If vehicle becomes first in queue then XXX = time remaining till discharge, tenths-of-a-second
6	150	31	ZZ = Current speed, fps.
7	151	33	Y = Acceleration or deceleration of vehicle during this time step, fpss
8	152	34	X = Turn code of vehicle.Code (0,1,2) indicates (left, thru, right) movement.
9	153	35	W = Code (0,1,2) if vehicle [is not, is, is (because of cycle failure)] in queue
10	154	41	XXXX = Number of vehicle in front of this vehicle
11	155	51	XXXX = Number of vehicle in back of this vehicle
12	156	61	ZZ = Desired free-flow speed, fps.
13	157	63	X = Driving characteristic of motorist

Table 50
INTRAS Link and Vehicle array parameter identification (concl.)

14	158	64	Y = Vehicle type code
15	159	65	W = Code (0,1) if vehicle is accelerating, decelerating)
16	160	71	XXX = Node number at which vehicle was diverted from freeway
17	161	81	XXX = Current ramp link number
			<u>VS</u>
1	162	11	YY = Origin node (last 2 digits)
2	163	13	XX = Destination node (last 2 digits)
3	164	15	X = Process code (0,1,2) if vehicle (has not, has , changed to left but has not) been processed this time step
4	165	21	W = current lane
5	166	22	XXXX = Distance of vehicle from upstream node, feet. If vehicle becomes first in queue then XXXX = time remaining till discharge, tenths-of-a-second
6	167	31	ZZ = Current speed, fps
7	168	33	Y = Acceleration or deceleration of vehicle during this time step, fpss.
8	169	34	X = Turn code of vehicle . Code (0,1,2) indicates (left, thru, right) movement
9	170	35	W = Code (0,1,2) if vehicle [is not, is,is (because of cycle failure)] in queue
10	171	41	XXXX = Number of vehicle in front of this vehicle
11	172	51	XXXX = Number of vehicle in back of this vehicle
12	173	61	ZZ = Desired free-flow speed, fps
13	174	63	X = Driving characteristic of motorist
14	175	64	Y = Vehicle type code
15	176	65	W = Code (0,1) if vehicle is (accelerating, decelerating)
16	177	71	XXX = Node number at which vehicle was diverted from freeway
17	178	81	XXX = Current surface link number

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ADDENDUM 1

DEVELOPMENT AND TESTING OF INTRAS,

A MICROSCOPIC FREEWAY SIMULATION MODEL

Volume II: User's Manual

1. INTRAS RESTART CAPABILITY

In an attempt to conserve computing time and costs, the INTRAS model was adapted to accept a restart option. This feature allows the user to freeze an image of the program common storage structure and peripheral files at a given point in time. The program could then be restarted at some future time and simulation continued by restoring the COMMON data base from the restart tape. The restart option has the following capabilities:

1) It is possible for a user to specify the simulated time, t, at which the program can be preserved such that a subsequent run may start executing at time, t. Thus, all appropriate COMMON blocks, local variables and peripheral files are written on a restart tape at time, t. A subsequent simulation run then reads the restart tape and begins execution at time, t. It is also possible for time, t, to occur during initialization.

2) It is possible for a user to specify an interval of simulated time, Δt, such that the program may be preserved at intervals of Δt. Using this option, the program can be restarted at the end of the last interval, Δt, in a subsequent run. Thus, all appropriate COMMON blocks, local variables and peripheral files are written on a restart tape at the end of each interval, Δt. A subsequent simulation run then reads the restart tape and begins execution at the end of the last interval, Δt. The restart tape is also written at intervals, Δt, during initialization, with the last write occurring at the end of initialization.

It is possible to use both options 1) and 2) above in the same simulation run.

The restart option is controlled by four input data items on the type 99 card. Due to the fact that up to two restart files may be dumped, a corresponding number of output file numbers have been allocated. In addition, an input file is required to restart the simulation.

Restart Option Files

File Number	Type	Contents
26	OUTPUT	This file contains the restart file dumped at the user-specified simulated time, t. It will not be written on again.
27	OUTPUT	This file contains the restart file dumped at the end of the last interval, Δt. At the end of the current interval, Δt, the file will be rewound and rewritten.
8	INPUT	This file contains the restart file which was previously dumped either on file 26 or file 27. It is used on runs which attempt to restart simulation.

2. REVISED INPUT SPECIFICATION

The restart capability input requirements are handled in total by the Type 99 card. The revised card format is described below.

One card type, the Run Control Card, is read by the INTRAS Supervisor module to define the type of run and indicate the lower level module to be called.

Run Control Card - Type 99

Cols.	Description
1	1 = Last 99 card request 0 (blank) = Another request follows
2	1 = Diagnostic run 2 = Simulation run 3 = Diagnostic + simulation 4 = Off-line incident detection run 6 = Simulation + off-line incident detection 7 = Diagnostic + simulation + off-line incident detection run 8 = Table of contents for case data tape 0 (blank) = No diagnostic, simulation or incident detection. (This would imply that Col. 24 will be specified, indicating an INPLOT or SAM run, or a stand-alone FUEL run will be indicated by a "1" in Col. 27.)
4-6	If Col. 2 = 2 or 6, then a data deck must be taken from the Case Data Tape. This field contains the sequence number of that data deck on the Case Data Tape.
7-9	As for Cols. 4-6, if a data deck must be taken from the Case Data Tape, then this field contains the Run Identification number of that deck (Cols. 61-63 of Type 00 card).

Both fields 4-6 and 7-9 may be specified concurrently or individually. If two decks on the Case Data Tape possess the same Run Identification number, then 4-6 must be speci-

fied. If the sequence number is not known, then the Run identification may be specified alone. If neither field is specified, then the case data must follow the 99 card in the input stream.

Cols.	Description
11	If this SIFT simulation is to produce output information on the Incident Data Tape, this field should be set = (1,2) if the Incident Data Tape (does not, does) contain previously stored detector data. Otherwise, this column should be left blank.
12	If this SIFT simulation is to produce output information on the INPLOT Data Tape, this field should be set = 1 if the INPLOT Data Tape is currently empty (i.e., no previous plot data sets have been stored on it). Otherwise, this column should be left blank.
14	If this diagnostic run (Col. 2 = 1, 3 or 7) data deck is to be stored on the Case Data Tape, this field must be specified as (1,2) if the Case Data Tape (does not, does) contain previously stored data decks. If the data deck is not to be stored, Col. 14 = 0 (blank).
15	If the statistical results of this simulation run Col. 2 = 2, 3, 6 or 7) is to be stored on the Statistical Data Tape for analysis by SAM, this field must be specified as (1,2) if the Statistical Data Tape (does not, does) contain previously stored data. If the statistical output is not to be stored, Col. 15 = 0 (blank).
16-18	Incident detection data specification. If Col. 2 was specified = 4, a previously stored set of data must be retrieved from the Incident Data Tape. The Run Identification number for that data must be entered in this field. Otherwise, leave this field blank.

Cols.	Description
21	For any incident detection run (Col. 2 = 4, 6 or 7), this field should be specified as [0 (blank), 1] if a list of the Run Identification numbers for those incident data sets on the Incident Data tape (is not, is) to be produced. If the purpose of this 99 card is only to produce this Run Identification list, Col. 2 should be specified as 4, Cols. 3-18 should be blank, and Col. 21 should be 1.
24	To specify that this 99 card is a request for an (INPLOT, SAM) program run, this field should be set (1,2). This field should only be specified if Cols. 2-21 are blank.
27	Code indication FUEL run type: = 0 if FUEL module is to be run along with simulation = 1 if FUEL module is to be run using data previously written on FUEL Data Tape, no simulation (implies that Col. 2 = 0) ≥ 2 if simulation only, no FUEL module
30	Code (0,1) if exogenous FUEL data cards (are not, are) to be read in. If so, cards appear after last type 60 card for this case.
33	Code (0,1) if FUEL Data Tape (is, is not) to be written during this simulation.
36	Code (0,1) if FUEL data tables (are not, are) to be printed out. Tables are always printed if Col. 30 = 1.
39	A flag indicating the type of Restart dumps to be made: 0 No dumps are to be made 1 A single dump at a time specified in Cols. 40-45 is to be made 2 Periodic dumps at time intervals specified in Cols. 48-50 are to be made 3 Both periodic and one-time dumps are to be made.

Cols.	Description
40-45	Time, in seconds, from the start of simulation when a dump is to be made. If this time is negative, the time is in the initialization period. May be used on the restart run.
48-50	The interval of time, in seconds, at which dumps are to be made. The dumps begin after the start of fill time. The last dump during fill time is after the last second of fill. May be used on a restart run.
52	A flag (0,1) if restart (is not, is) to be attempted. If so, all other parameters except the last card in Col. 1 may be left blank. If a restart is to be attempted, the restart file must exist on file 8. Restart dumps may be made on a run which has been restarted from a previous file.
79,80	$\equiv$ 99 (Card Type)

3. ADDITIONAL INTRAS MODULE ERROR MESSAGES

Code	Message
10	Improper Restart Dump parameter, IRDMP. Pl should be between zero and three, inclusive. Col. 39 on the type 99 card.
11	Improper periodic dump time interval, Pl. Value is in seconds and should be greater than zero. Cols. 48-50 on the type 99 card.
12	Improper Restart parameter, Pl. Should be (0,1) for (no attempt, try) to restart. Col. 52 on the type 99 card.
13	A single Restart dump has been requested at time, Pl. This time should not equal zero. Cols. 40-45 on the type 99 card.

4. NEW COMMON BLOCKS REQUIRED

COMMON/RSTRT/IFTSTR, IFDLT, IFSTRT, ITSTAR, ITDELT, IRSTRT, IRDMP, ITPD

IFTSTR — File number of the peripheral file where the dump at a specific time, ITSTAR, is to be made.

IFDLT — File number of the peripheral file where the dumps at interval, ITDELT seconds, are to be made.

ITSTAR — Time, in seconds, from the start of simulation when a dump is to be made. If ITSTAR is negative, the time is in the initialization period.

ITDELT — The interval of time, in seconds, at which dumps are to be made. The dumps begin after the start of fill time. The last dump during fill time is after the last second of fill.

IRSTRT — A flag (0,1) if restart (is not, is) to be attempted.

IFSTRT — File number of the peripheral file where the restart data file is located.

IRDMP — A flag (0,1,2,3):
0 No dumps to be made
1 One dump at time, ITSTAR, only
2 Periodic dumps at interval, ITDELT, only
3 Both periodic and one-time dumps.

ITPD — Flag indicating the type of dump to be made during the current time step = (0,1,2,3) for (none, one-time, periodic, both).

COMMON/SEQU/IFSEQ(10), JFSEQ

IFSEQ — An array which contains up to ten reasons to leave the high activity overlay to process periodic functions. This array is loaded in subroutine LOCTST.

JFSEQ — The number of entries in IFSEQ.

5. ADDITIONAL SUBROUTINE CALL CROSS REFERENCE CHART

	CALLING ROUTINES								
CALLED ROUTINES	HICON*	CLNUP*	FXCHNF	FXCHNL	LOCON*	DMPOUT	DMPIN	DOIDFL	DIIDFL
LOCTST	X								
FXCHNF		X							
FXCHNL		X							
LASTLK*			X						
NEXTLN*				X					
DMPOUT					X				
DMPIN					X				
DOODF						X			
DOIDFL						X			
POSIT								X	X
DIIDFL							X		
DIDDF							X		
DOFDF						X			
DIFDF							X		

*Pre-existing routines

6. SUBROUTINE-COMMON BLOCK CROSS REFERENCE CHART

	INTRAS	BLKDAT	SIFT	HICON	LOCTST	FXCHNF	FXCHNL	DMPIN	DMPOUT
A1	X	X	X			X	X	X	X
A2	X	X		X		X		X	X
A3	X	X		X				X	X
A4	X	X						X	X
A5	X	X						X	X
A6	X	X		X				X	X
A7	X							X	X
A8	X							X	X
A9	X							X	X
A10	X							X	X
A11	X	X						X	X
A12	X							X	X
ACTO	X	X						X	X
ACT1	X							X	X
ACT2	X							X	X
ACT3	X							X	X
ACT4	X							X	X
ACT7	X							X	X
ACT8	X							X	X
ACT9	X							X	X
ACT10	X							X	X
ACT12	X							X	X
ACT20	X							X	X
CFUEL	X		X					X	X
CONTRL	X		X	X	X	X		X	X
CRASH		X	X		X			X	X
DBLEXP	X							X	X
ERTRAN	X		X					X	X
FORINC	X		X	X	X			X	X
FPAR	X							X	X
FREDAT	X							X	X
IHEAD	X							X	X
INCOMP			X	X				X	X
IPLTN	X		X					X	X
LASDCH	X							X	X
NFILTS	X							X	X
NIDTSV			X					X	X
NRGY			X					X	X
ONVEH	X							X	X
P1	X							X	X

	INTRAS	BLKDAT	SIFT	HICON	LOCTST	FXCHNF	FXCHNL	DMPIN	DMPOUT
RANK	X							X	X
S1	X	X						X	X
S2	X		X	X	X	X		X	X
S3	X		X	X	X			X	X
SIZE	X	X	X	X		X	X	X	X
VBUF			X					X	X
VPOINT			X	X				X	X
RSTRT	X	X	X		X			X	X
SEQU			X		X				

	DOIDFL	POSIT	DIIDFL	DOODF	DIDDF	DOFDF	DIFDF
CFUEL						X	X
CONTRL	X	X		X	X	X	X
RSTRT	X		X	X	X	X	X

ADDENDUM 2

DEVELOPMENT AND TESTING OF INTRAS,

A MICROSCOPIC FREEWAY SIMULATION MODEL

Volume II: User's Manual

1. NEW COMMON BLOCK FOR BLOCKING THROUGH LANE NEXT TO AUXILLARY LANE LEADING TO EXIT RAMP

COMMON/BLKLN/NVSTP(110)

NVSTP(L) = XXXXYYYY

A packed word which contains information on an exiting vehicle on link L which is the leading such vehicle in a through lane next to an exiting lane and is trying to enter the exiting lane:

XXXX = Vehicle number

YYYY = Distance from upstream node of link L to the "virtual incident" which is set up to slow down vehicle XXXX to a crawl speed of 6fps.

This array is referenced in subroutines

STOPFL, FMOVE, CLRAL, LCLRAL, DMPIN, DMPOUT, CHANGE

2. NEW COMMON BLOCK INDICATING WHETHER A VEHICLE TRACING ERROR HAS BEEN DISCOVERED

COMMON/CHNERR/ICHNER

ICHNER Scalar switch denoting whether a vehicle tracing error has been found. $(0,\neq 0)$ = (no error, error).

This array is referenced in subroutines

FMOVE, FRSTV

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FEDERALLY COORDINATED PROGRAM (FCP) OF HIGHWAY RESEARCH AND DEVELOPMENT

The Offices of Research and Development (R&D) of the Federal Highway Administration (FHWA) are responsible for a broad program of staff and contract research and development and a Federal-aid program, conducted by or through the State highway transportation agencies, that includes the Highway Planning and Research (HP&R) program and the National Cooperative Highway Research Program (NCHRP) managed by the Transportation Research Board. The FCP is a carefully selected group of projects that uses research and development resources to obtain timely solutions to urgent national highway engineering problems.*

The diagonal double stripe on the cover of this report represents a highway and is color-coded to identify the FCP category that the report falls under. A red stripe is used for category 1, dark blue for category 2, light blue for category 3, brown for category 4, gray for category 5, green for categories 6 and 7, and an orange stripe identifies category 0.

FCP Category Descriptions

1. Improved Highway Design and Operation for Safety

Safety R&D addresses problems associated with the responsibilities of the FHWA under the Highway Safety Act and includes investigation of appropriate design standards, roadside hardware, signing, and physical and scientific data for the formulation of improved safety regulations.

2. Reduction of Traffic Congestion, and Improved Operational Efficiency

Traffic R&D is concerned with increasing the operational efficiency of existing highways by advancing technology, by improving designs for existing as well as new facilities, and by balancing the demand-capacity relationship through traffic management techniques such as bus and carpool preferential treatment, motorist information, and rerouting of traffic.

3. Environmental Considerations in Highway Design, Location, Construction, and Operation

Environmental R&D is directed toward identifying and evaluating highway elements that affect the quality of the human environment. The goals are reduction of adverse highway and traffic impacts, and protection and enhancement of the environment.

4. Improved Materials Utilization and Durability

Materials R&D is concerned with expanding the knowledge and technology of materials properties, using available natural materials, improving structural foundation materials, recycling highway materials, converting industrial wastes into useful highway products, developing extender or substitute materials for those in short supply, and developing more rapid and reliable testing procedures. The goals are lower highway construction costs and extended maintenance-free operation.

5. Improved Design to Reduce Costs, Extend Life Expectancy, and Insure Structural Safety

Structural R&D is concerned with furthering the latest technological advances in structural and hydraulic designs, fabrication processes, and construction techniques to provide safe, efficient highways at reasonable costs.

6. Improved Technology for Highway Construction

This category is concerned with the research, development, and implementation of highway construction technology to increase productivity, reduce energy consumption, conserve dwindling resources, and reduce costs while improving the quality and methods of construction.

7. Improved Technology for Highway Maintenance

This category addresses problems in preserving the Nation's highways and includes activities in physical maintenance, traffic services, management, and equipment. The goal is to maximize operational efficiency and safety to the traveling public while conserving resources.

0. Other New Studies

This category, not included in the seven-volume official statement of the FCP, is concerned with HP&R and NCHRP studies not specifically related to FCP projects. These studies involve R&D support of other FHWA program office research.

* The complete seven-volume official statement of the FCP is available from the National Technical Information Service, Springfield, Va. 22161. Single copies of the introductory volume are available without charge from Program Analysis (HRD-3), Offices of Research and Development, Federal Highway Administration, Washington, D.C. 20590.